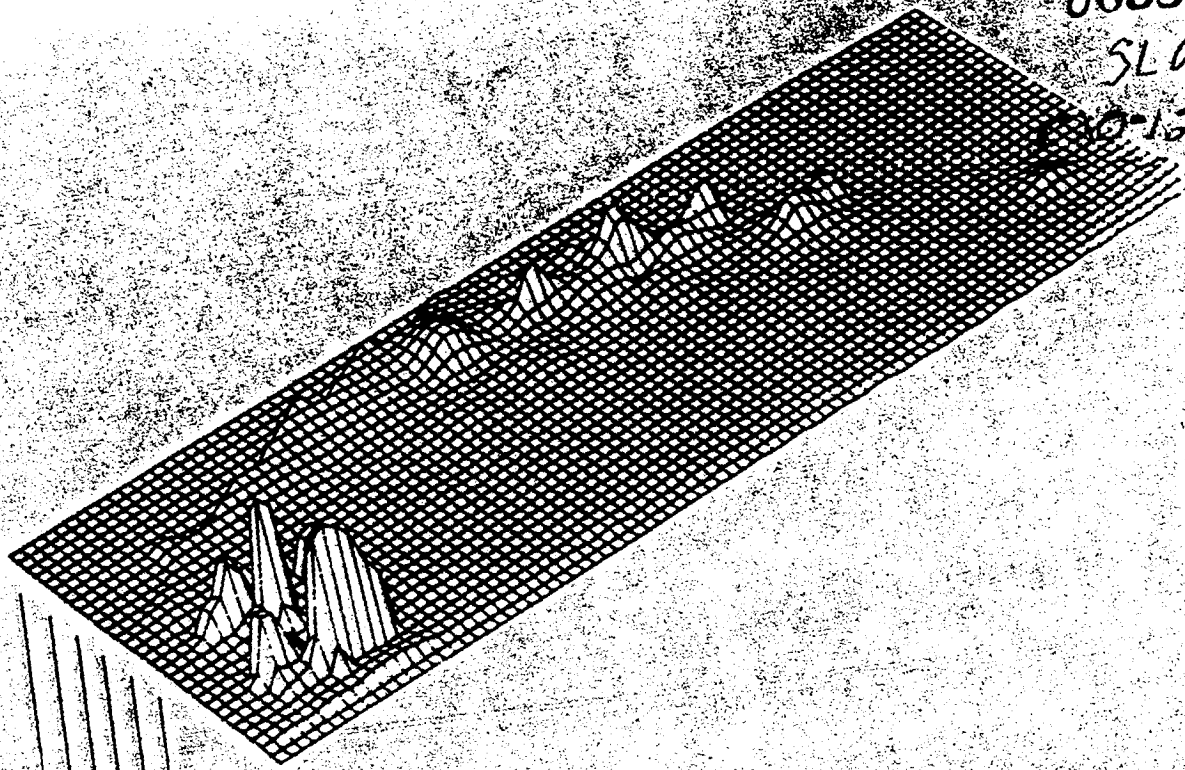


003814-02

SL004

DO-1276



Formerly Utilized Sites
Remedial Action Program
St. Louis Airport Storage Site (SLAPSS)

SLAPSS Technical Series :

Vol. 3 Data Management System

No. 1 Conceptual Systems Design

January 1982

MO/SLAPSS
DOE/OR/20722-1
C.2

BNI 10-05-22A-001

WESTON
DESIGNERS CONSULTANTS

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Printed in the United States of America
Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

NTIS price codes
Printed copy: 6.50
Microfiche copy: A01

FORMERLY UTILIZED SITES
REMEDIAL ACTION PROGRAM
ST. LOUIS AIRPORT STORAGE SITE (SLAPSS)

TECHNICAL SERIES

Vol. 3 Data Management System

No. 1 Conceptual Systems Design

January 1982

Prepared for

Oak Ridge National Laboratory
Oak Ridge, Tennessee

Contract Number 32C-705-18C

Prepared by

Roy F. Weston, Inc.
Designers-Consultants
West Chester, Pennsylvania

TABLE OF CONTENTS

<u>Section</u>	<u>Title</u>	<u>Page</u>
	FOREWARD	vii
1	INTRODUCTION	1-1
2	CONCEPTUAL APPROACH	2-1
3	SYSTEM OVERVIEW	3-1
4	MAJOR SYSTEM COMPONENTS	4-1
	4.1 Data Entry	4-1
	4.2 Data Base Files	4-2
	4.3 Processing Modules	4-11
	4.4 Representative Output	4-27
5	CONCLUSION	5-1

LIST OF TABLES

<u>Table No.</u>	<u>Title</u>	<u>Page</u>
4-1	Cross Reference Summary Processing Modules/Output Capabilities	4-12

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
2-1	Data Management Requirements SLAPSS/FUSRAP	2-2
2-2	SLAPSS/FUSRAP Data Management Systems Concept	2-5
3-1	System Overview SLAPSS/FUSRAP	3-2
4-1	SLAPSS/FUSRAP Data Base Files	4-3
4-2	File Organization - Site History File SLAPSS/FUSRAP	4-4
4-3	File Organization - Site Physical File SLAPSS/FUSRAP	4-6
4-4	File Organization - Site Geotechnical File SLAPSS/FUSRAP	4-7
4-5	File Organization - Sampling/Analysis File SLAPSS/FUSRAP	4-9
4-6	Three Dimensional Interpretation of Topography SLAPSS	4-28
4-7	Three Dimensional Topography with Super- imposed Locations of Wells and Gamma Log Readings - 1976 SLAPSS	4-29
4-8	Three Dimensional Topography with Super- imposed Locations of Wells and Gamma Log Readings - 1981 SLAPSS	4-30
4-9	Three Dimensional Interpretation of External Gamma Radiation - 1M Above the Surface (1976) SLAPSS	4-31
4-10	Three Dimensional Interpretation of Beta Gamma Radiation - 1CM Above the Surface (1976) SLAPSS	4-32

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>	<u>Page</u>
4-11	Three Dimensional Interpretation of Surface Concentrations of Uranium 238 (1976) SLAPSS	4-33
4-12	Rotated Three Dimensional Representation of Surface Pile - Latty Avenue Site	4-34
4-13	Two Dimensional Topographic Contours - Point Value Map - Latty Avenue Site	4-35
4-14	Two Dimensional Topographic Contours - Point Value Map (1979) SLAPSS	4-36
4-15	Point Value Map, External Gamma Radiation 1M Above the Surface (1976) SLAPSS	4-37
4-16	Example of Grain Size Distribution - Gradient Curve SLAPSS	4-38
4-17	Example of X-Y Plot of Gamma Radiation Intensity Versus Depth SLAPSS	4-39
4-18	Example of Hydrometer Analysis Work Sheet SLAPSS	4-40
4-19	Example of Well Masterfile Data SLAPSS	4-41
4-20	Example of Water Table/Piezometric Surface Data SLAPSS	4-42
4-21	Example of Well Log Data SLAPSS	4-43
4-22	Chronology of Key Events SLAPSS	4-44
4-23	Example of Volume of Cross-Sectional Segments of a Given Mass SLAPSS	4-45

FOREWORD

In late 1980, the Department of Energy (DOE) contracted with the Oak Ridge National Laboratory (ORNL) to initiate a research and development program with the ultimate objective of demonstrating in situ stabilization for containment and control of radioactive contaminants at the St. Louis Airport Storage Site (SLAPSS).

The St. Louis Airport storage site project is being conducted as a part of the DOE initiated Formerly Utilized Sites Remedial Action Program (FUSRAP). The St. Louis Airport site is one of several sites, formerly utilized by the Corps of Engineers' Manhattan Engineer District (MED) and the U.S. Atomic Energy Commission (AEC), for the initial production of nuclear materials for national defense and security.

Sites, including SLAPSS, were later decontaminated in accordance with the standards and survey methods then in existence. However, radiological criteria guidelines and proposed guidelines for release of sites for unrestricted use became more stringent as research on the effects of low-level radiation progressed. As a result, FUSRAP was initiated in 1974 to identify these formerly-utilized MED/AEC sites and to reevaluate their radiological status. The ultimate objective of FUSRAP is to decontaminate sites to permit their unrestricted use, or to stabilize and control residual activity to meet current criteria for protection of public health and safety.

One of the steps in the overall FUSRAP management plan is engineering evaluation, including an evaluation of suitable means of stabilizing residual radioactivity, where appropriate, including investigation of pertinent aspects of site geology, hydrology, and meteorology.

This document is part of a technical series to present the results of the ORNL activity and deals with the development of tools and techniques for stabilization of radioactive contaminants at the St. Louis Airport site. Specifically, the information relates to the work being performed, under subcontract to ORNL and to Bechtel National, Inc. by Roy F. Weston, Inc. (WESTON), in providing site characterization, preengineering conceptual evaluation, engineering for peripheral decontamination, conceptual engineering plans for radon and groundwater contamination control, and environmental monitoring plans.

SECTION 1

INTRODUCTION

In late 1980, the Department of Energy (DOE) contracted with the Oak Ridge National Laboratory (ORNL) to initiate a research and development program with the ultimate objective of demonstrating in situ stabilization for containment and control of radioactive contaminants at the St. Louis Airport Storage Site (SLAPSS). Under subcontract, Roy F. Weston, Inc. (WESTON) provided site characterization, pre-engineering conceptual evaluation, peripheral decontamination engineering, and conceptual engineering services.

The first task initiated by WESTON in the SLAPSS project was to:

1. Collect all available site characterization data;
2. Evaluate the data for content and sufficiency relative to the data needs associated with in-situ containment and control; and
3. Describe the specific known characteristics of the SLAPSS for use in further control option evaluation and program development.

During the performance of this task, the need for computerized data management and analysis became quite evident. As a result, the development of a data management system capable of supporting the data management and analysis requirements of the SLAPSS/FUSRAP study was initiated during the second phase of the SLAPSS project.

In order to maintain the required level of support for the on-going field activities at the SLAPSS site, the development and implementation of the SLAPSS/FUSRAP data management system is designed to be accomplished in phases over the life of the SLAPSS research and development effort. The initial phase consisted of:

1. Development of an overall System Design Document including definition of all the major system components as well as their interrelationships.

2. Implementation of basic modules needed to support the on-going site characterization activities.

This initial phase was completed and the currently available portions of the Data Management System successfully used in support of the effort described in the SLAPSS Volumes 1 and 2 - Site Characterization, Site History, Topographical and Radiological Data Analysis, Geological and Hydrological Data and Engineering, Conceptual Design for in Situ Stabilization of Low Level Radioactive Residues.

Presented in this document are the conceptual approach used in the development of the overall Data Management System as well as a discussion of the system overview and each of the Major System components. The organization for this document is as follows:

1. Introduction
2. Conceptual Approach
3. System Overview
4. Major System Components
5. Conclusion

SECTION 2

CONCEPTUAL APPROACH

Characterization of a FUSRAP site such as SLAPPS requires the management of data from numerous and diverse data collection activities. Associated with these activities are various dependent and independent data components such as radiological conditions, hydrogeologic descriptions, site physical characteristics, and relevant site operational history. In order for the various professional disciplines involved with the Remedial Action Program to effectively utilize these data, a capability must exist which centrally records, stores, analyzes and displays the data through a variety of standard techniques. Thus arises the need for a comprehensive computerized data management system capable of supporting the unique data and analysis requirements of the SLAPPS/FUSRAP program.

The data management functions needed to reach the project objective of in situ conceptual engineering evaluation are:

1. Data Entry
2. Information Integration
 - Data Storage
 - Data Analysis
 - Data Presentation
3. Evaluation and Decision.

The relationship of these functional data management requirements with the basic components of a computerized data management system is illustrated in Figure 2-1.

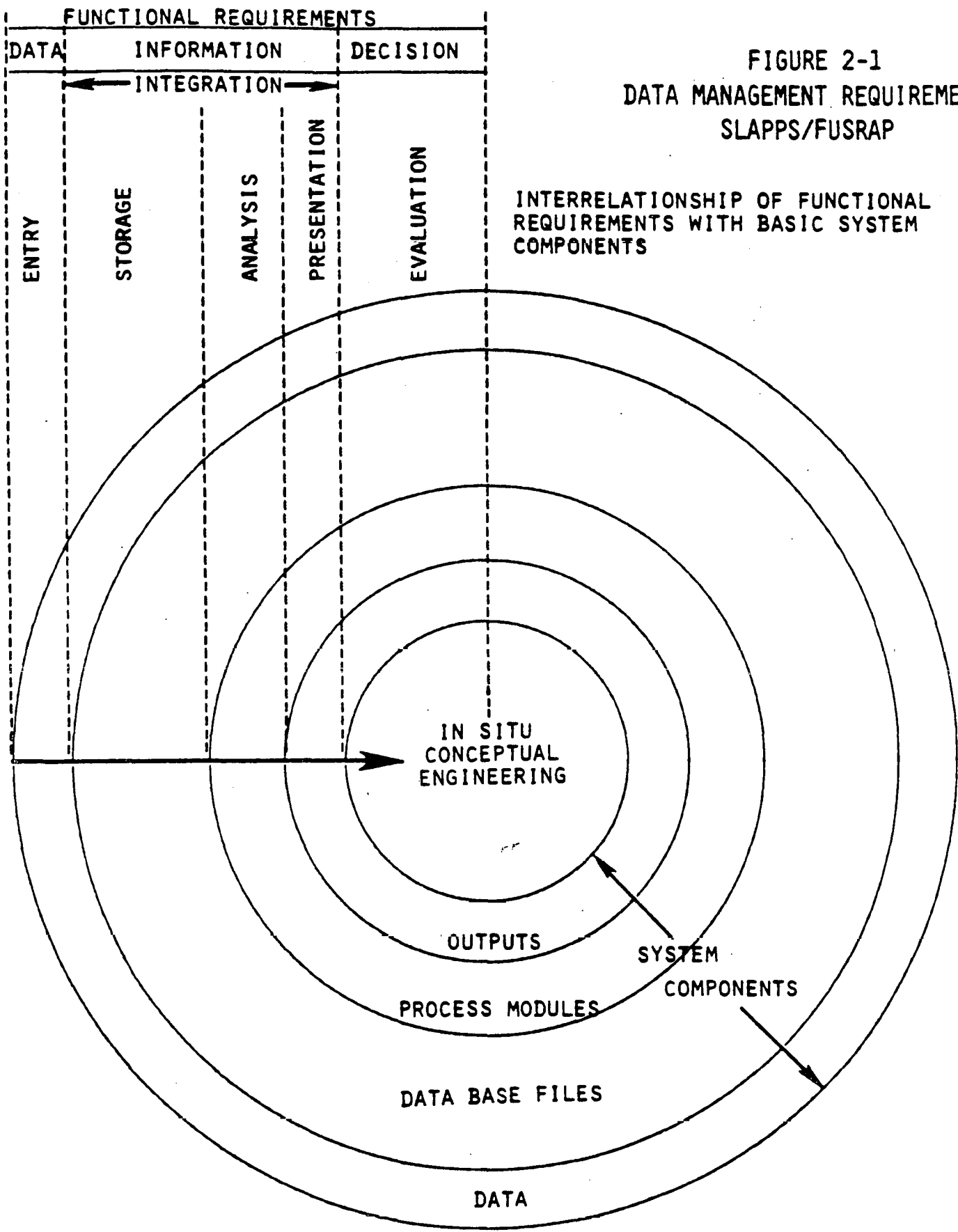


FIGURE 2-1
DATA MANAGEMENT REQUIREMENTS
SLAPPS/FUSRAP

As shown, a computerized data management system consists of four basic components:

1. Data
2. Data Base Files
3. Process Modules
4. Outputs

It is the efficient management of the interrelationship of these components through the various functional stages which provides the successful vehicle for achieving the program objective.

Evaluation of the above requirements identified the following attributes needed by such a system:

1. Comprehensive, centralized file management structure with minimum data redundancy
2. Multi-site capability able to support the overall FUSRAP program if so desired.
3. Modular approach to processing components to permit development and implementation on an "as needed" basis.
4. Independence of data files from processing software.
5. Maximum use of available standard software.
6. Functional development of processing software and resultant output.
7. Graphical and tabular output capability.
8. Data editing and review capability.

WESTON's approach to meeting these needs was the design and development of a modularized data management system built around a central data base core. The construction of such a system would thus permit a standardized approach to the site characterization methodology, yet provide the flexibility necessary to meet specific demands posed by unique site situations. This systems approach is conceptually illustrated in Figure 2-2. Shown again are the four basic system components (data, data base files, process modules, and output). Added are the specific data elements and components necessary to meet the system's objectives.

Basically, the system accepts data from the various field surveys and incorporates site-related information such as the location of known contaminants, physical structures and features, and topographic data. These data are then stored in various data base files organized to provide maximum flexibility and minimal redundancy. Processing modules then interact with the appropriate data base files to analyze and present these data in various output formats for further evaluation by the appropriate professional disciplines, ultimately leading to a suitable in situ conceptual engineering solution.

To insure that the needs identified previously were addressed, certain guidelines were established to govern the system design and development. Specifically, these included:

1. Modular approach to software development - processing modules would be functionally oriented with maximum use of interfacing with existing capabilities.
2. Standard Data Base system - use of a commercially available data base software system to provide central data management software. Permits maximum use of utility entry and edit functions as well as ad hoc data manipulation.
3. Generic approach to data - permitted applicability to multiple sites as well as data parameters.

2-5

Adherence to these guidelines permitted WESTON to meet the two major objectives established for this phase of the system development:

1. Overall system design.
2. Implementation of processing modules as needed to support on-going activities.

SECTION 3

SYSTEM OVERVIEW

The SLAPPS/FUSRAP Data Management System embodies the data entry, storage, integration, presentation and analysis functions necessary to support the data requirements associated with a FUSRAP program. Although initially designed to support the SLAPPS research and development effort, the system has a multi-site capability and can be used to support activities at other sites concurrently or independently. An overview of the Data Management System, identifying the major system components and illustrating their relationships, is presented in Figure 3-1.

Basically, the SLAPPS/FUSRAP Data Management System contains the following major components:

1. Data Entry
2. Data Base Files
3. Processing Modules
4. Outputs

Via these major system components, the system will accept data from the various field surveys and incorporate site-related information such as the location of known contaminants, location of physical structures and natural features and topographic data. The resultant data base, through the processing modules, is then used to "overlay" specific data components with known site information to facilitate the selection of the appropriate remedial action.

The data base functions as the core or center of the data management system. It is a collection of independent sub-files logically connected by a network of supporting software. Within each file are the various record types that logically define specific segments of the data area represented by the file. Each record in turn contains those data elements which characterize the content of the particular record type.

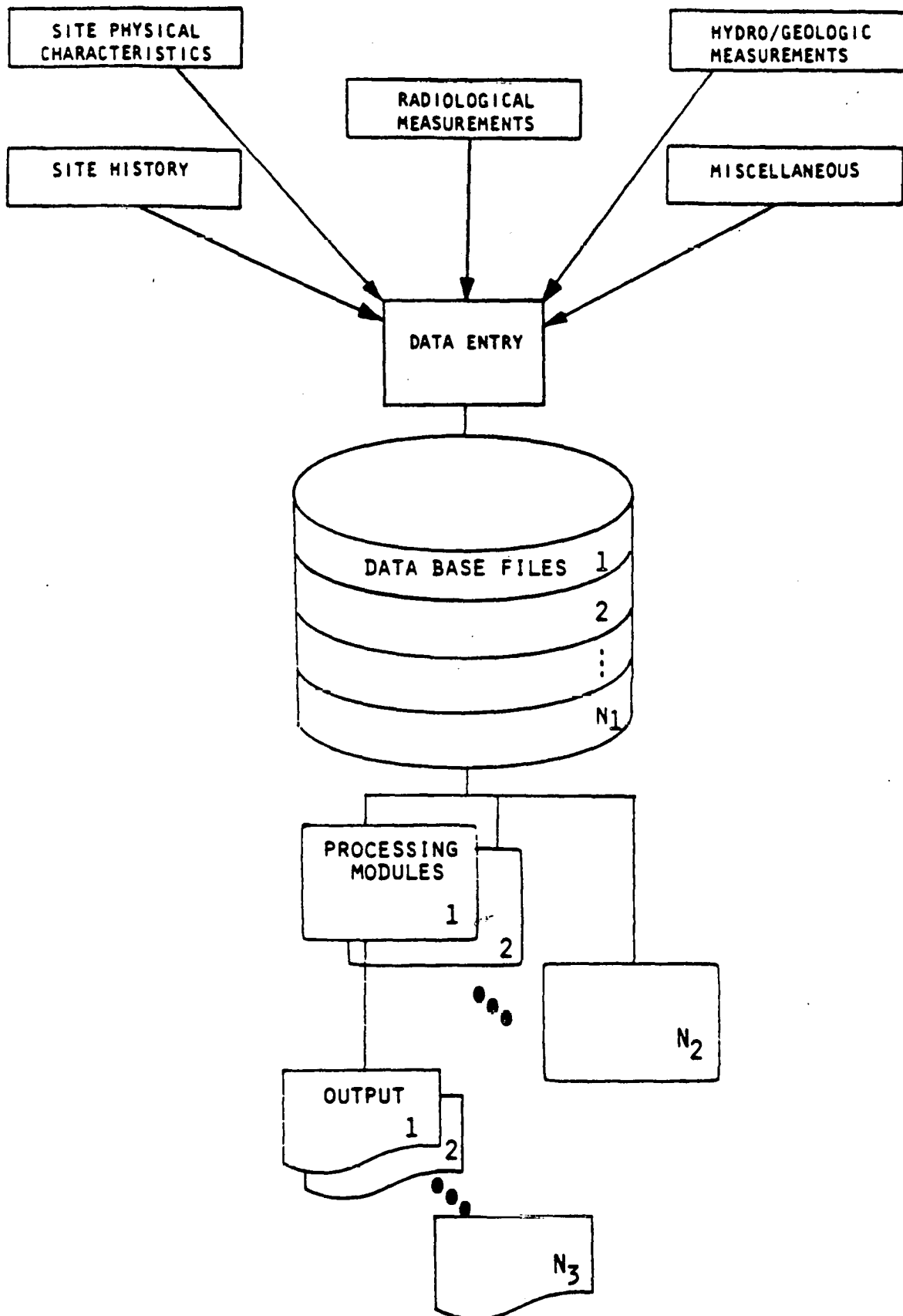


FIGURE 3-1
SYSTEM OVERVIEW SLAPSS/FUSRAP

The approach taken in the design of this system was to categorize the processing into a number of self-contained modules. Each module contains programs specific to its function. Several important advantages result from this approach. Modular systems are inherently less complex than non-modular systems due to the fewer interconnections involved. Also, systems with fewer interconnections are easier to understand. Since each module is designed to be as self-contained as possible, the system can respond to changing processing needs. By using only those modules pertinent to the particular processing requirements of the application, the system can efficiently respond to the situation at hand.

Output is a function of the processing module involved. Capabilities include tabular reporting, graphic representation and data plotting. Data can also be output to various computer-compatible storage media when needed for further processing.

Discussions of each of the Major System Components is presented in Section 4. Also included are representative samples of output generated by the modules currently implemented.

SECTION 4

MAJOR SYSTEM COMPONENTS

As mentioned previously and illustrated in Figure 3-1, the SLAPPS/FUSRAP Data Management System has four major functional system components:

1. Data Entry
2. Data Base Files
3. Processing Modules
4. Output

Discussions of each of these components are presented in the following subsections.

4.1 Data Entry

Data collected and/or generated during studies such as the SLAPPS/FUSRAP program, come from a variety of sources. Accordingly, flexibility must be maintained relative to means of data entry. The system is designed to enter data via multiple avenues, including punched card, magnetic tape, or terminal keyboard entry. To minimize development costs, the data management system design utilizes standard operating system and data base utility software to enter the data into the appropriate data base files. The capability to edit and modify the data as needed is inherent in the data base software utilized.

4.2 Data Base Files

The SLAPPS/FUSRAP Data Management System is based around a central data base management software system. A commercially available data base software package, DMS-1100, was designed into the system to function in this capacity. Detailed technical descriptions of the various components of this package may be referenced in the appropriate Sperry-Univac product documentation. It should be noted that implementation of the data base software was not possible during the current phase of activity due to delivery schedules. Temporary file structures were used to support the on-going site characterization activities.

The organizational design of the various data components and files within the data base is hierarchial. An overview of the data base file organization is presented in Figure 4-1. Basically, the data base is organized into four files:

1. Site History File
2. Site Physical File
3. Site Geotechnical File
4. Sampling/Analysis File

The organization of the Site History File is shown in Figure 4-2. It consists of three basic types of records: Key Event data, Operational History data, and Materials Handled data. Specific data elements contained in each of these record types are presented below.

Key Events Records

- Date of key event
- Description of key event

Operational History Records

- Description of operation
- Materials handled
- Dates

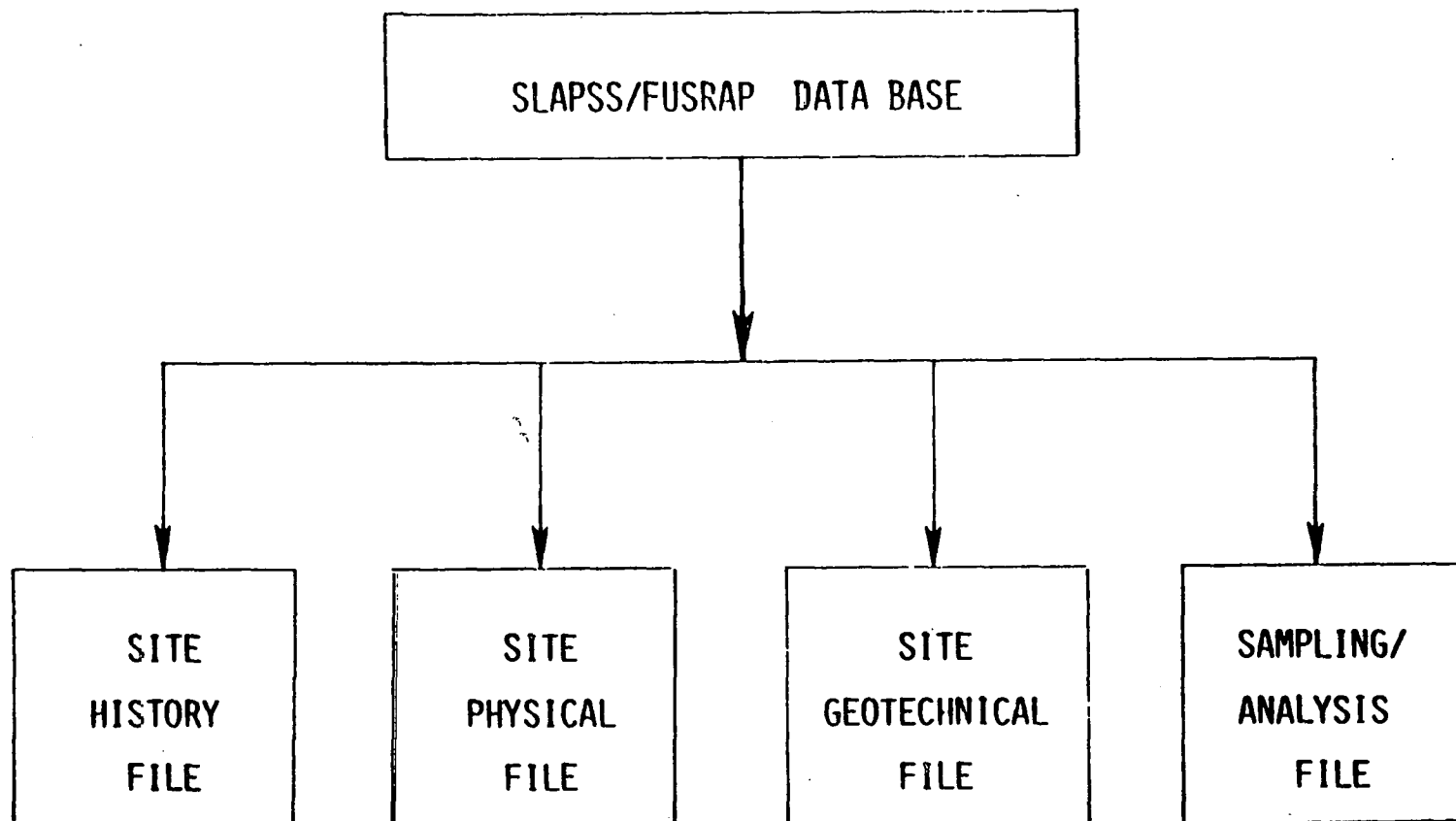


FIGURE 4-1
SLAPSS/FUSRAP DATA BASE FILES

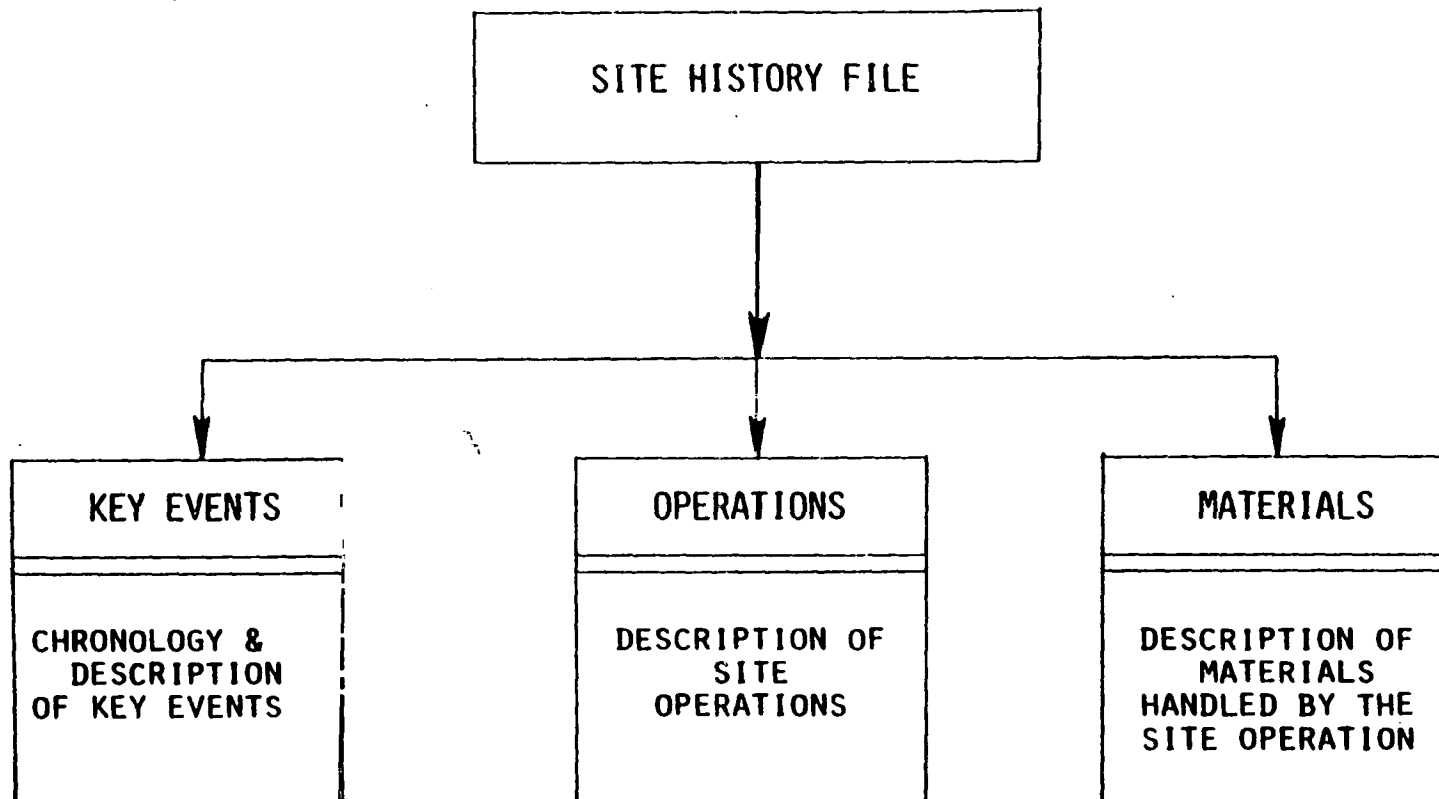


FIGURE 4-2
FILE ORGANIZATION - SITE HISTORY FILE
SLAPSS/FUSRAP

Materials Handled Records

- Materials Handled
- Operation
- Description of material including chemical and radiological parameters

The Site Physical File, shown in Figure 4-3, likewise contains three record types. These include:

Master Grid Records

- Master coordinate reference system
- Reference parameters necessary to link grid system to standard U.S. Geologic Survey benchmarks

Site Layout Records

- Description of physical site layouts (current and former)
- Location of key landmarks
- Location of previous storage areas

Site Topography Records

- Coordinated grid reference data and elevations for each topographic survey conducted at the site
- Survey data

The Site Geotechnical File contains all data relative to the definition of the sites' geotechnical regime. Referring to Figure 4-4, it is organized into four types of data records, namely:

Well Description Records

- Location of all wells drilled
- Descriptive data on each well including depth, screen intensity, size of casing, etc.

Lithologic Log Records

- Well reference including locations
- Definition of strata as defined by specific boring

SITE PHYSICAL FILE

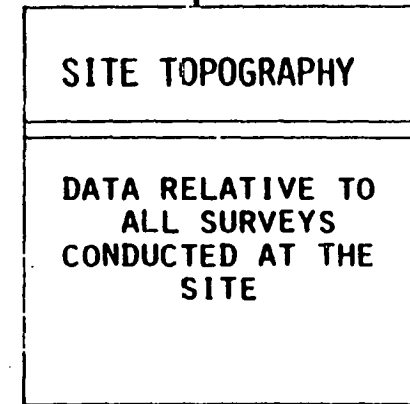
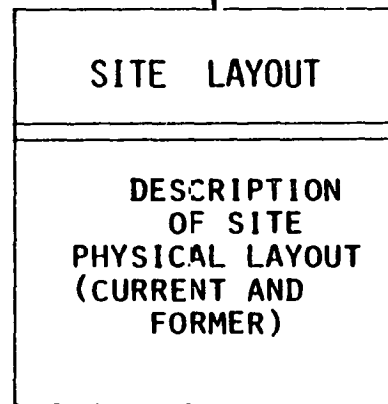
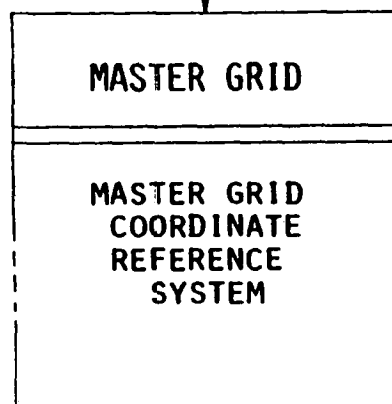
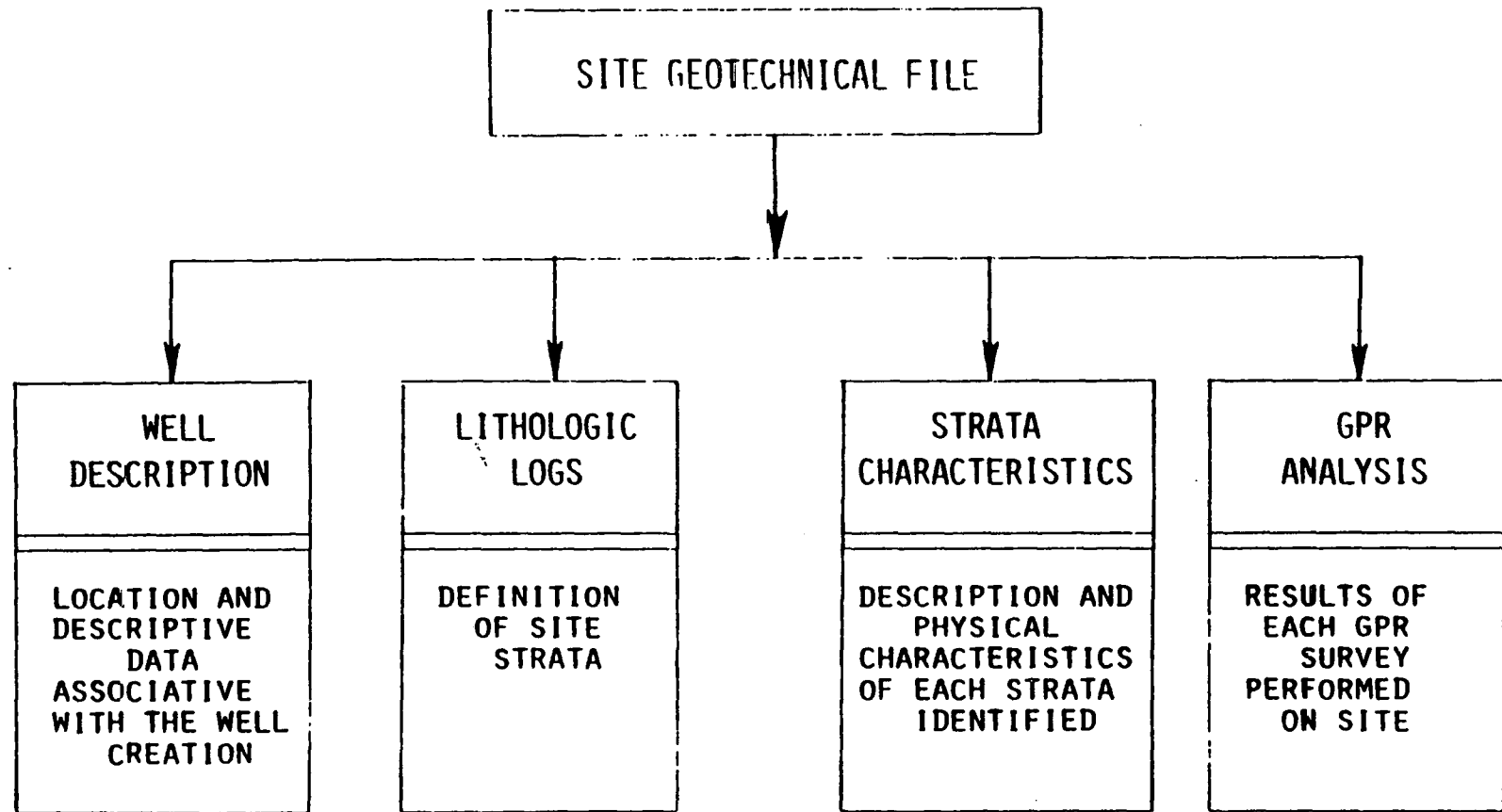


FIGURE 4-3
FILE ORGANIZATION - SITE PHYSICAL FILE
SLAPSS/FUSRAP



4-7

WESTON

FIGURE 4-4
FILE ORGANIZATION - SITE GEOTECHNICAL FILE
SLAPSS/FUSRAP

Strata Characteristic Records

- Description and location of site strata
- Physical characteristics of each strata including pertinent engineering parameters such as permeability and grain size

GPR Analysis Records

- Description of each GPR survey including location
- Definition of object identified
- Summary results of each survey by location

The fourth data base file is the Sampling/Analysis File shown in Figure 4-5. It essentially contains all pertinent sampling and analytical data associated with any measurements taken at the project site. Common data elements include:

1. Sample I.D. and Methodology
2. Analytical Results and Methodology
3. Accuracy
4. Parameters Measured
5. Date Sampled and Analyzed
6. Comments
7. Sample Location Information

The data records and types of data included are grouped as follows:

Radiological Records

- Surface measurements for multiple parameters
- Subsurface loggings

Chemical Records

- Subsurface Chemicals
- Surface radionuclides
- Radon gas measurements
- Surface chemicals

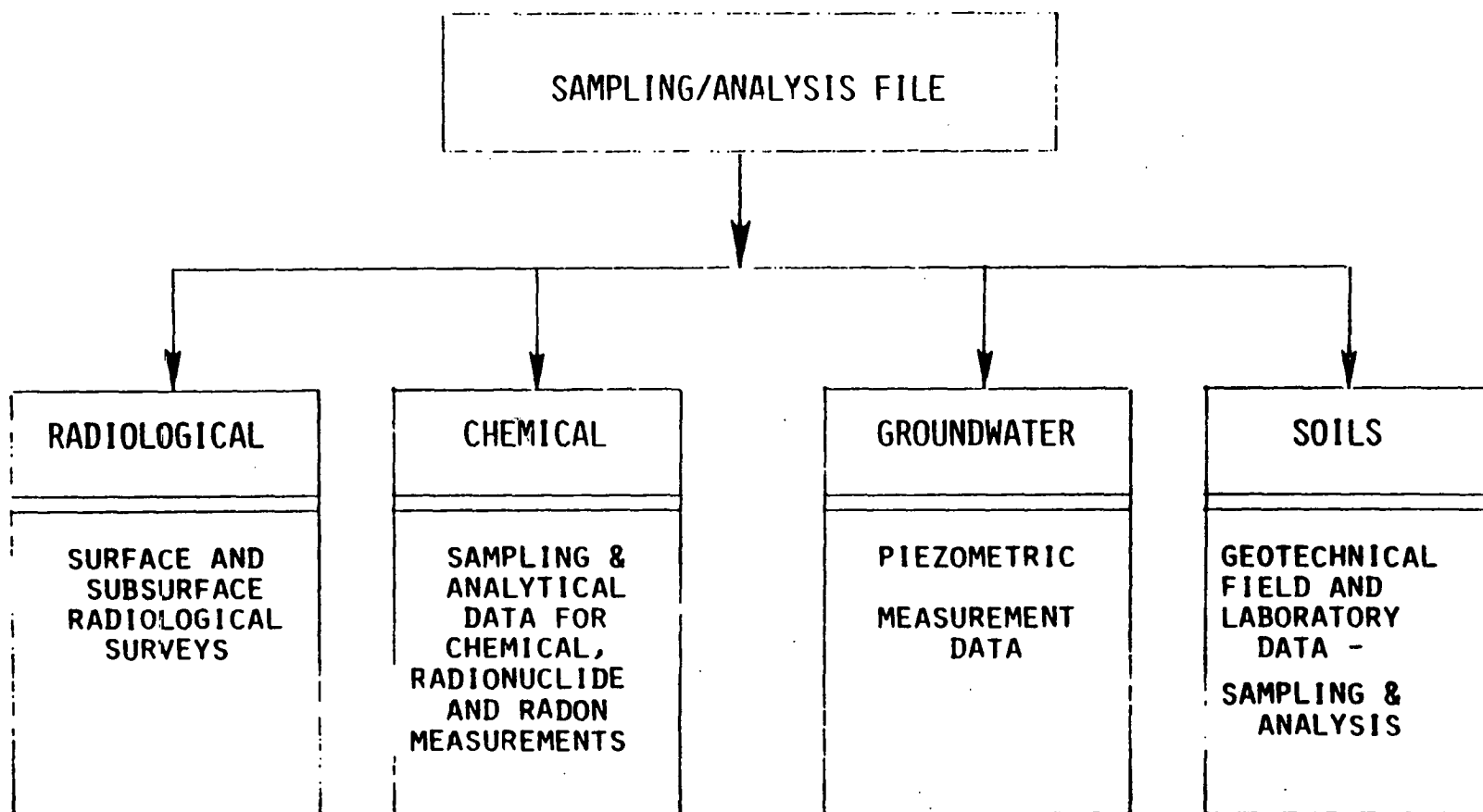


FIGURE 4-5
FILE ORGANIZATION - SAMPLING/ANALYSIS FILE
SLAPSS/FUSRAP

Groundwater Records

- Piezometric water level data
- Slug testing results

Soils Records

- Geotechnical field sample measurements
- Laboratory sample analyses
- Hydrometer analyses
- Particle size distribution

4.3 Processing Modules

As previously mentioned, the driving forces in the design and development of the system's processing modules were:

1. Modularity
2. Independence of data files from processing software
3. Development on an as-needed basis to support on-going activity.

Utilization of the modular approach coupled with the independence of the data file structure from the processing software eliminated the need to predefine all processing modules prior to system implementation. Accordingly, only those modules needed to support the on-going site characterization activities of the current study phase were defined. A summary of these processing modules as well as a cross reference to their respective output is presented in Table 4-1. Descriptions of the function of each module are presented in the following pages.

TABLE 4-1
CROSS REFERENCE SUMMARY
PROCESSING MODULES/OUTPUT CAPABILITY¹

OUTPUT CAPABILITY PROCESSING MODULES (NAME)	TABULAR REPORTS	PLOTS		GRAPHS	INTER- MEDIATE FILE
		2D	3D		
ANALYTICAL DATA PREPARA- TION (ANAL PREP)					X
CHRONOLOGICAL REPORT OF KEY EVENTS (CHRON)	4-22				
ISOPLETH PLOT (CONTR)		4-13 4-14			
HYDROMETER ANALYSIS REPORT (HYDANL)	4-18			4-16	
POINT VALUE PLOT (MAPAT)		4-15			
NUMERICAL APPROXIMATION (NUPRX)					X
THREE-DIMENSIONAL PLOT (THREED)			4-6 4-9 4-10 4-11 4-12		

TABLE 4-1 (Con't)

<div style="display: flex; justify-content: space-between;"> <div>OUTPUT CAPABILITY</div> <div>PROCESSING MODULES (NAME)</div> </div>	TABULAR REPORTS	PLOTS		GRAPHS	INTER- MEDIATE FILE
		2D	3D		
THREE-DIMENSIONAL WELL LOG PLOT (THREED1)			4-7 4-8		
VOLUMETRIC CALCULATION (VOLUM)	4-23				
PIEZOMETRIC SURFACE REPORT (WATPEZ)	4-20				
WELL MASTERFILE REPORT (WLWTM)	4-19				
WELL-LOG STRATIGRAPHIC REPORT (WLWTS)	4-21				
WELL LOG PLOT (XY PLOT)				4-17	

¹Numbers represent figure numbers in Section 4-4.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: ANALPREP

ANALYTICAL DATA PREPARATION

DESCRIPTION:

Retrieves user selected data parameters from the appropriate data base files and generates an intermediate data file of these parameters to be used for further processing by external standardized software such as statistical packages.

DATA INPUT:

Data parameters selected by user analyst.

OUTPUT:

Intermediate disk file of selected parameter data.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: CHRON

CHRONOLOGICAL REPORT OF KEY EVENTS

DESCRIPTION:

Produces a printer output of significant events
in chronological order.

DATA INPUT:

Dates and descriptions of significant events.

OUTPUT:

Tabular list.

See Figure 4-22.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: CONTR

ISOPLETH PLOT

DESCRIPTION:

Randomly spaced data values have been previously described in a gridded manner by the NUPRX module. These equally spaced values are read by CONTR and developed into maps of isopleths. The data values may be for any variable which can be represented in plan view over the site (e.g., elevation, radiological readings, piezometric surface elevation, elevation difference, etc.)

DATA INPUT:

Values of a particular variable occurring in equally spaced intervals (i.e., gridded data from the NUPRX module).

OUTPUT:

Isopleth maps.

See Figure 4-13, 4-14.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: HYDANL

HYDROMETER ANALYSIS REPORT

DESCRIPTION:

Laboratory Hydrometer Analysis of soil samples to determine the grain size distribution. Produces values of temperature, different concentrations, and hydrometer readings versus time. These values are read by the module and stored. Results of calculations performed on this data results in tabular values or semi-log plots of grain size versus percent finer. The grain size of specific percentages (D90, D50, D40) are also calculated and used to determine the uniformity coefficient.

DATA INPUT:

Laboratory readings associated with hydrometer analyses.

OUTPUT:

Semi-log plot of grain size distribution and work sheet of intermediate data values and percentage of specific grain sizes.

See Figure 4-16, 4-18.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: MAPAT

POINT VALUE PLOT

DESCRIPTION:

Randomly spaced data values are read with their coordinate location by MAPAT. The module then plots these values on a map at their point of occurrence.

DATA INPUT:

Values of a particular variable occurring in randomly spaced intervals.

OUTPUT:

Point value maps.

See Figure 4-15.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: NUPRX

NUMERICAL APPROXIMATION

DESCRIPTION:

Randomly spaced data values are read with their coordinate location by NUPRX. Through a process of localized, weighted, least-squares fitting, data values for a uniformly-spaced grid are produced and stored for use by other modules.

DATA INPUT:

Values of a particular variable occurring in randomly spaced intervals.

OUTPUT:

Disk file of gridded data values.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: THREED

THREE-DIMENSIONAL PLOT

DESCRIPTION:

Equally spaced (gridded) data values are read and represented by a three-dimensional plot of the surface described by those values. The data values may be for any variable which can be represented in plan view over the site.

DATA INPUT:

Values of a particular variable occurring in equally spaced intervals (i.e., gridded data from the NUPRX module).

OUTPUT:

Gridded three-dimensional plot of a continuous surface.

See Figure 4-6,
4-9 through 4-12.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: THREED1

THREE-DIMENSIONAL WELL LOG PLOT

DESCRIPTION:

Gridded topographic data and information from well log readings is read by the module. A three-dimensional plot is produced which indicates the relationship between the X, Y, and Z location of well log reading and the value of that reading. The readings are located in space relative to the surface and represented by means of circles which are proportional in size to their intensity.

DATA INPUT:

Values of a topographic surface occurring in equally spaced intervals (gridded). Also well log information and location.

OUTPUT:

Gridded three-dimensional plot of existing topographic surface with superimposed representations of well log readings.

See Figure 4-7, 4-8.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: VOLUM

VOLUMETRIC CALCULATION

DESCRIPTION:

Using gridded topographic information from the NUPRX module as an upper confining surface and lower surface, information volumes are calculated for cross-sectional segments and totaled for the entire mass. The lower surface may be described by:

1. The NUPRX module;
2. A level plane;
3. A flat surface of known slope.

DATA INPUT:

Elevation values at equally spaced increments (gridded) of upper and lower confining surfaces.

OUTPUT:

Tabular list by cross-sectional segment of volume of a given mass.

See Figure 4-23.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: WATPEZ

PIEZOMETRIC SURFACE REPORT

DESCRIPTION:

A printer listing of each well is produced with an observed ground water elevation, and the date the observation was made. The observations are listed by group in chronological order.

DATA INPUT:

Well identification, date of piezometric reading, piezometric elevation.

OUTPUT:

Tabular list.

See Figure 4-20.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: WLWTM

WELL MASTERFILE REPORT

DESCRIPTION:

Each well is identified through a code system and listed with: date of creation, depth, screened interval, casing diameter, location on master coordinate system, and its measuring point elevation.

DATA INPUT:

Well identification with related information for each.

OUTPUT:

Tabular list of wells and related information.

See Figure 4-19.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: WLWTS

WELL LOG-STRATIGRAPHIC REPORT

DESCRIPTION:

Produces a printer listing of each well with the type and depth delineation of all stratigraphic units encountered.

DATA INPUT:

Stratigraphic well log data.

OUTPUT:

Tabular list by well of stratigraphic unit and depth of occurrence.

See Figure 4-21.

FUSRAP/SLAPPS DATA MANAGEMENT SYSTEM

PROCESSING MODULE DESCRIPTION

PROCESSING MODULE NAME: XY PLOT

WELL LOG PLOT

DESCRIPTION:

Well log information is read and represented by a plot of intensity versus elevation. Actual elevation is calculated from surface elevation at the well site and depth of log readings.

DATA INPUT:

Well log information, location of well, and surface elevations at well locations.

OUTPUT:

Plot of intensity of well log readings versus elevation with indication of existing and previous surface elevations.

See Figure 4-17.

4.4 Representative Output

Representative samples of output generated by the system processing modules currently installed are presented as follows:

PLOTS

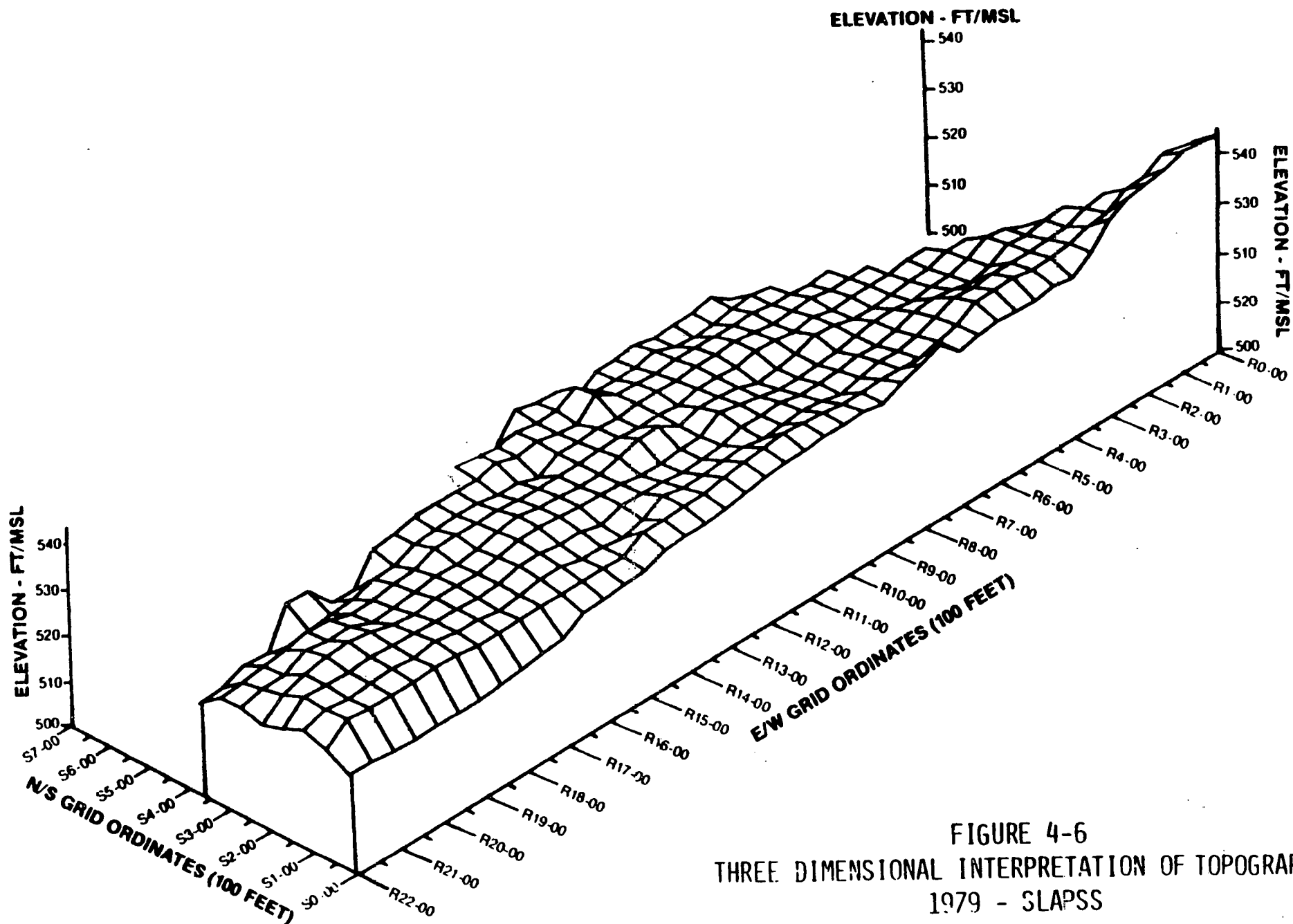
- | | | |
|-------------|----|--|
| Figure 4-6 | —— | Three dimensional topography |
| Figure 4-7 | —— | Three dimensional topography with super- |
| 4-8 | | imposed locations of wells and gamma log |
| | | readings |
| Figure 4-9 | —— | Three dimensional interpretation of sur- |
| | | face external gamma radiation |
| Figure 4-10 | —— | Three dimensional interpretation of sur- |
| | | face beta gamma radiation |
| Figure 4-11 | —— | Three dimensional interpretation of sur- |
| | | face concentrations of Uranium 238 |
| Figure 4-12 | —— | Rotated three dimensional representation |
| | | of surface pile |
| Figure 4-13 | —— | Two dimensional topographic contour |
| 4-14 | | and/or point value maps |
| 4-15 | | |

GRAPHS

- | | | |
|-------------|----|---------------------------------------|
| Figure 4-16 | —— | Grain size distribution |
| Figure 4-17 | —— | X-Y plot of gamma radiation intensity |
| | | versus depth |

TABULAR REPORTS

- | | | |
|-------------|----|---|
| Figure 4-18 | —— | Hydrometer analysis work sheet |
| Figure 4-19 | —— | Well masterfile data |
| Figure 4-20 | —— | Water table/piezometric surface data |
| Figure 4-21 | —— | Well log data |
| Figure 4-22 | —— | Chronology of key events |
| Figure 4-23 | —— | Volume of cross-sectional segments of a |
| | | given mass |



NOTE: THIS MAP IS BASED ON SITE SURVEYS
BY ROWLAND SURVEYING CO

WESTON

FIGURE 4-6
THREE DIMENSIONAL INTERPRETATION OF TOPOGRAPHY
1979 - SLAPSS

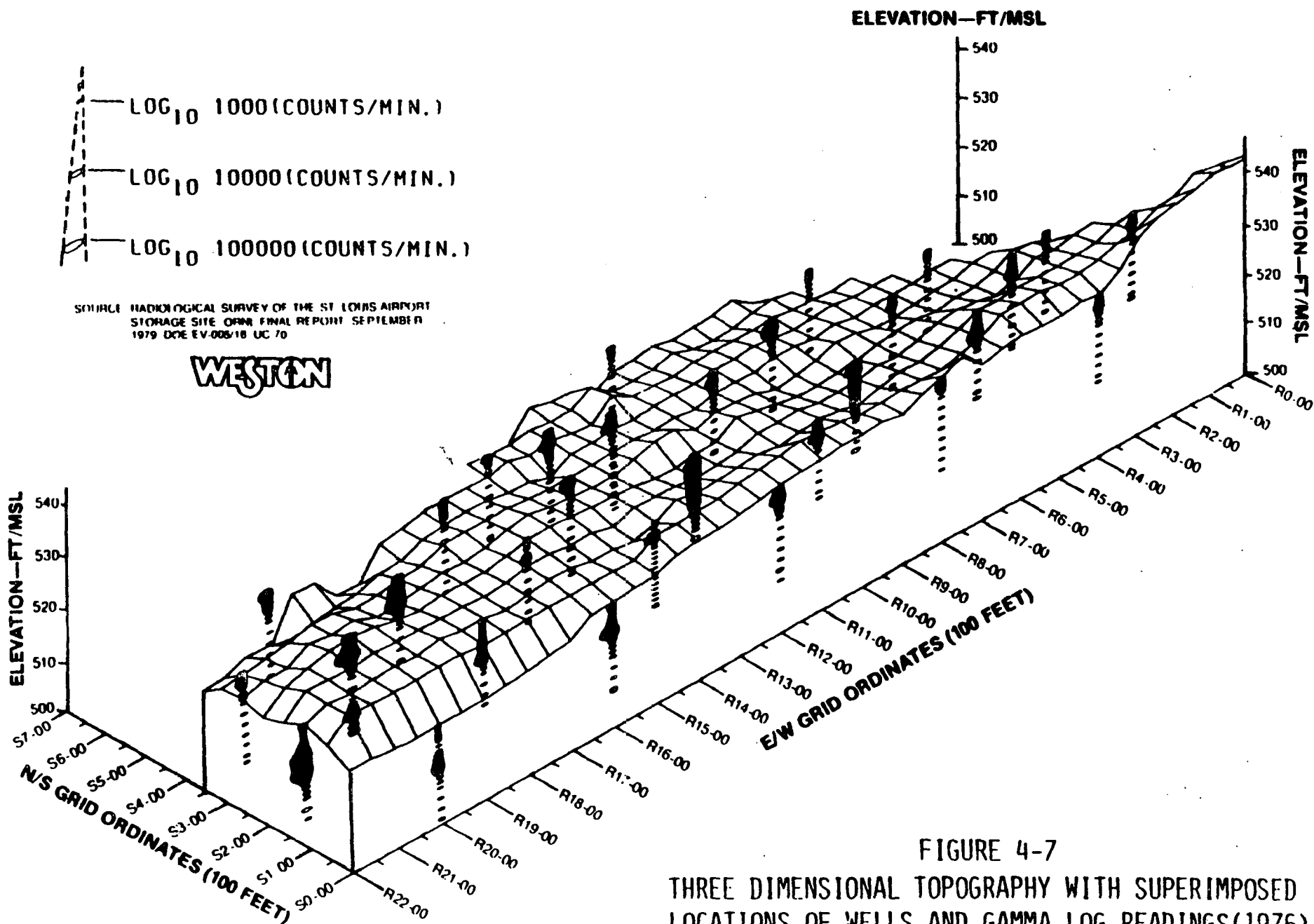
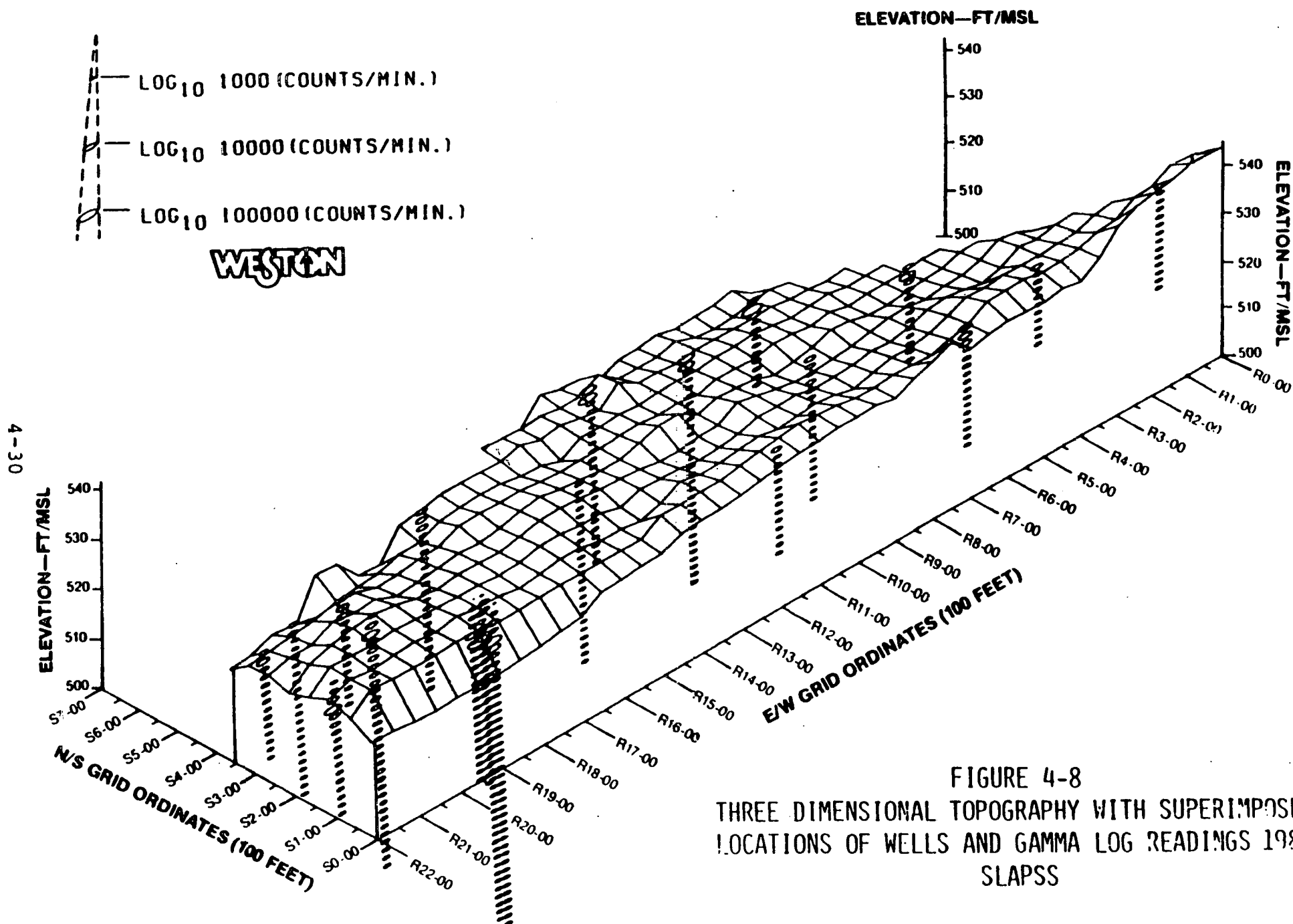
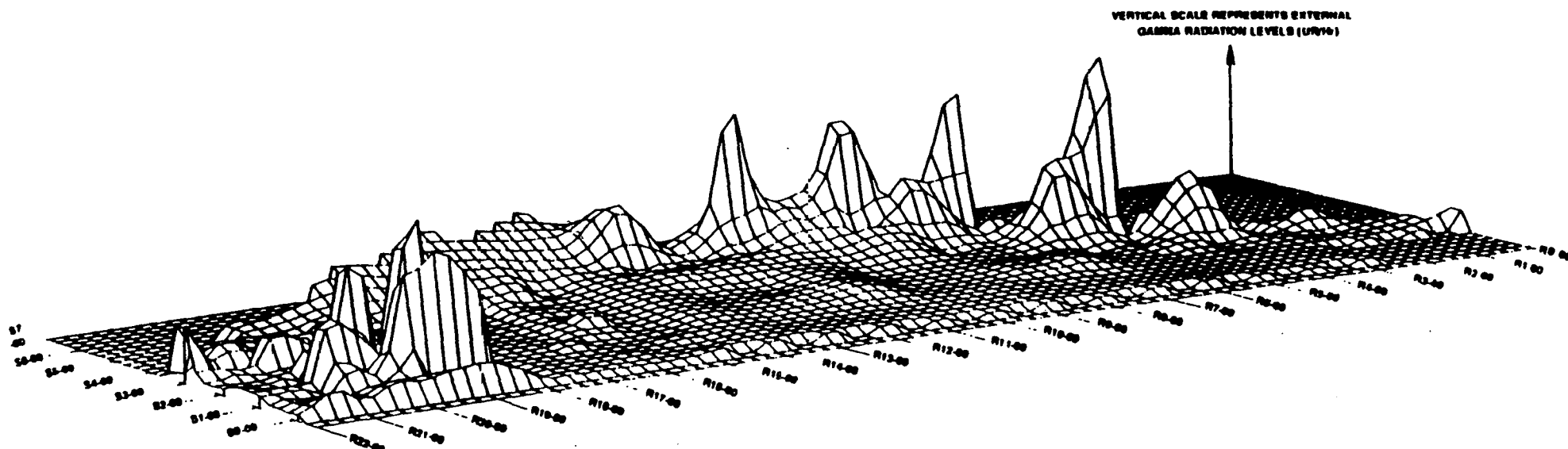


FIGURE 4-7
THREE DIMENSIONAL TOPOGRAPHY WITH SUPERIMPOSED
LOCATIONS OF WELLS AND GAMMA LOG READINGS(1976)
SLAPSS



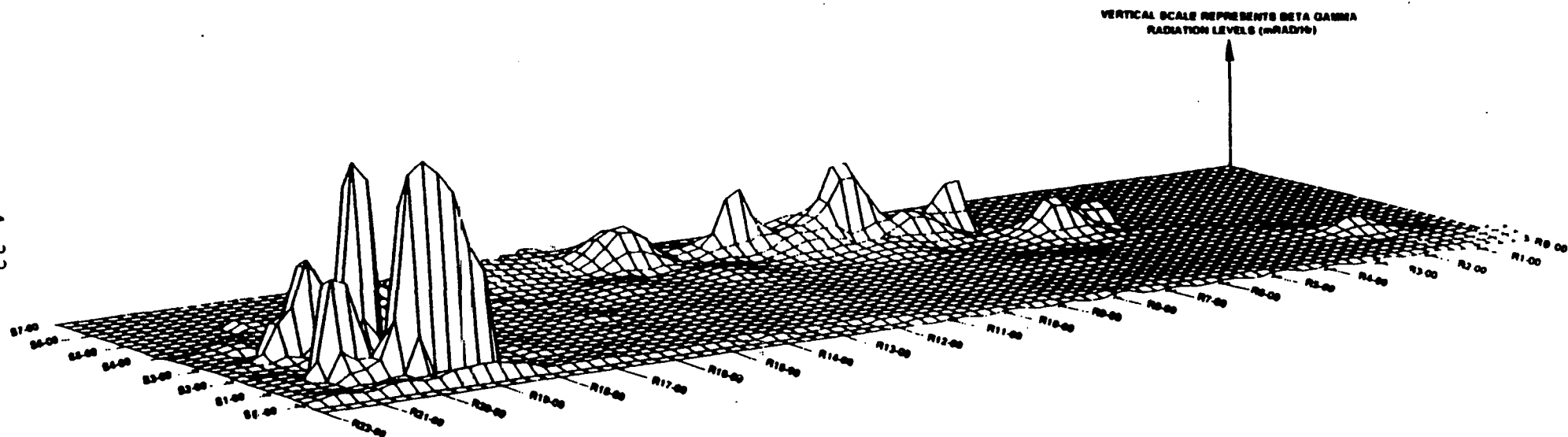


ST. LOUIS AIRPORT STORAGE SITE

WIREFRAME PLOT OF SURVEY OF THE ST. LOUIS AIRPORT STORAGE SITE
1976 FINAL REPORT SEPTEMBER 1976 (DO NOT SCALE)

WESTON

FIGURE 4-9
THREE DIMENSIONAL INTERPRETATION OF EXTERNAL
GAMMA RADIATION - 1M ABOVE THE SURFACE (1976)
SLAPSS

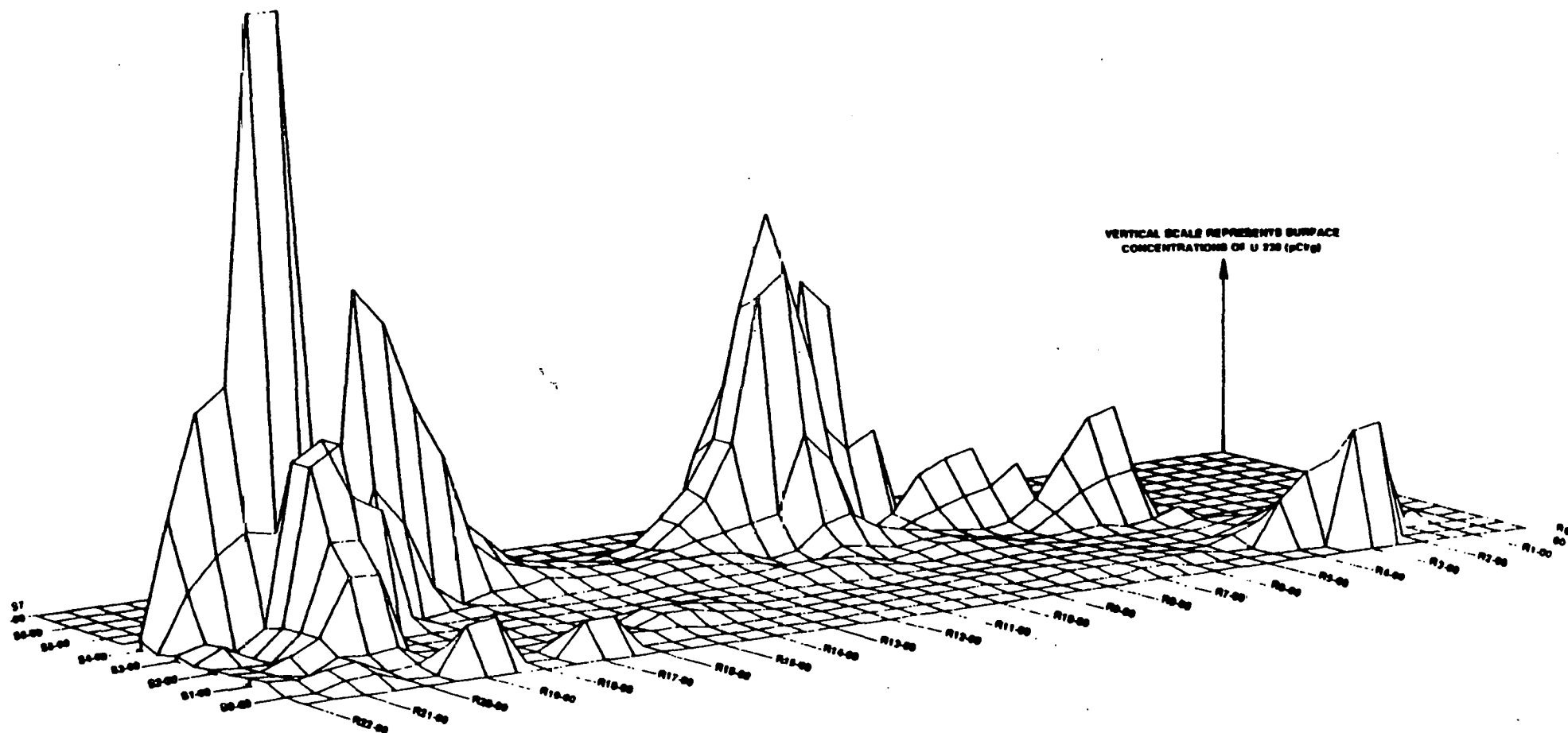


ST. LOUIS AIRPORT STORAGE SITE

SOURCE: RADIOLOGICAL SURVEY OF THE ST. LOUIS AIRPORT STORAGE SITE
ORNL PDA REPORT SEPTEMBER 1976 FILE 114 000 10 US 76

WESTON

FIGURE 4-10
THREE DIMENSIONAL INTERPRETATION OF BETA GAMMA
RADIATION - 1CM ABOVE THE SURFACE (1976) SLAPSS

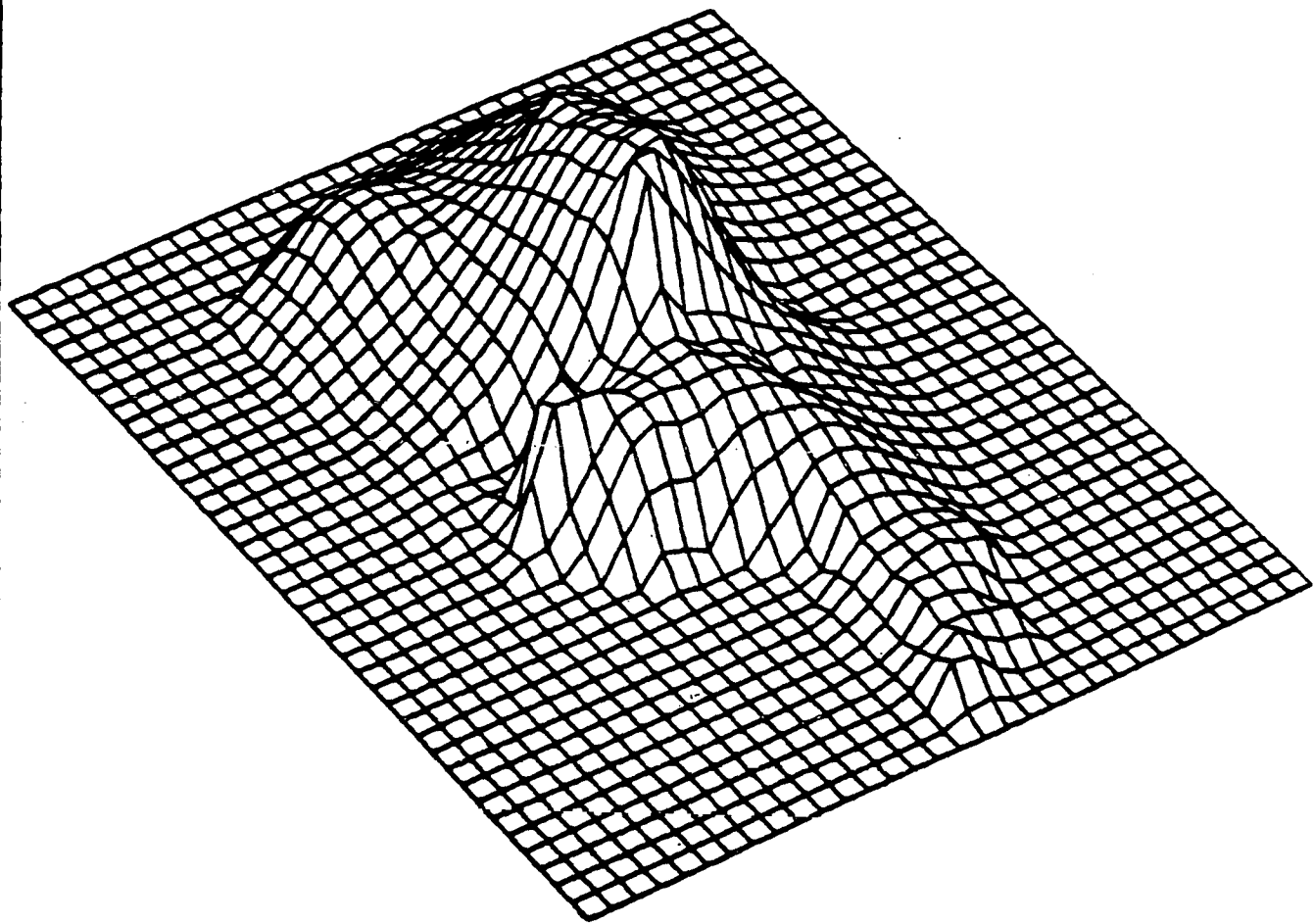


ST. LOUIS AIRPORT STORAGE SITE

UNCLASSIFIED REPORT FOR THE ST. LOUIS AIRPORT STORAGE SITE
 1986 FINAL REPORT TO THE ST. LOUIS AIRPORT STORAGE SITE

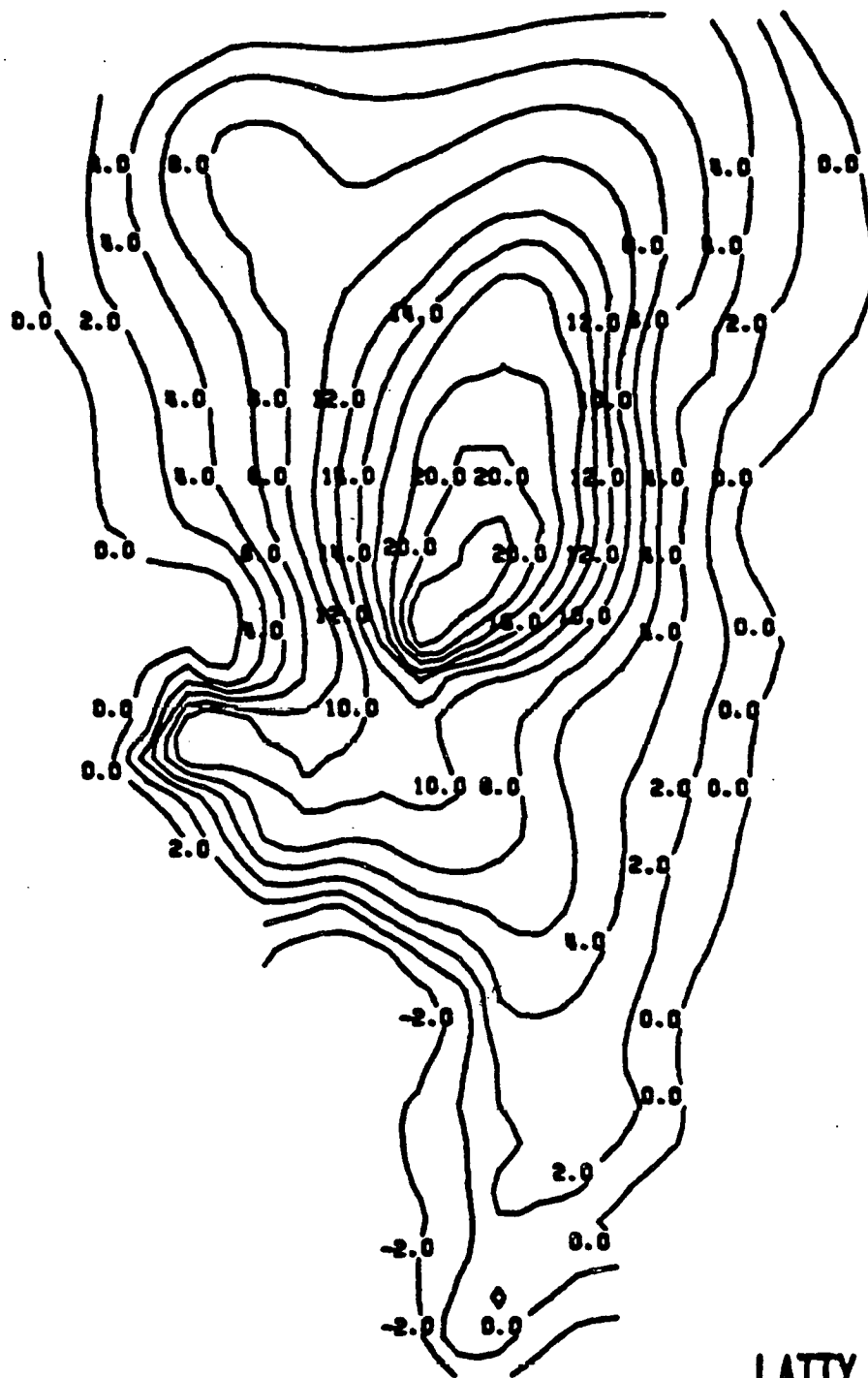
WESTON

FIGURE 4-11
 THREE DIMENSIONAL INTERPRETATION OF SURFACE
 CONCENTRATIONS OF URANIUM 238 (1976) SLAPSS



LATTY AVENUE SITE

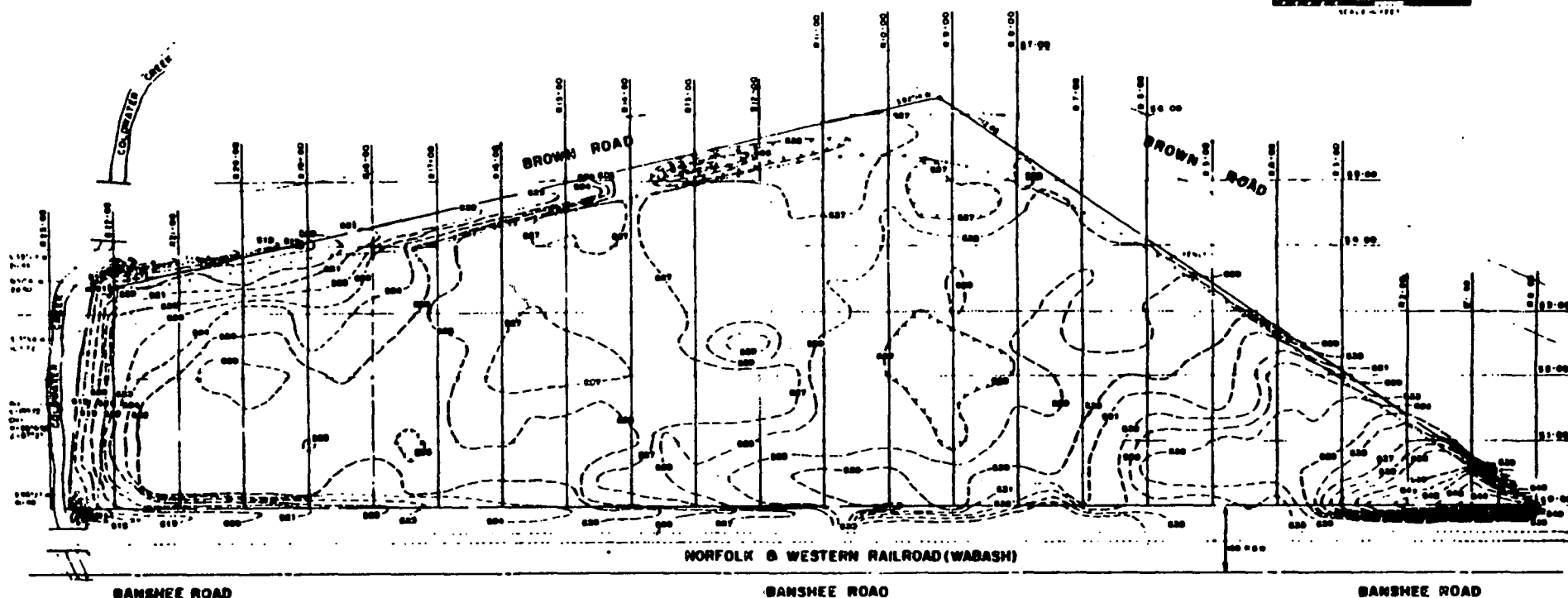
FIGURE 4-12
ROTATED THREE DIMENSIONAL REPRESENTATION OF
SURFACE PILE - LATTY AVENUE SITE



LATTY AVENUE SITE

FIGURE 4-13
TWO DIMENSIONAL TOPOGRAPHIC CONTOURS -
POINT VALUE MAP - LATTY AVENUE SITE

4-36



Elevation 0000 to 0005
 0000 to 0005
 0000 to 0005
 0000 to 0005

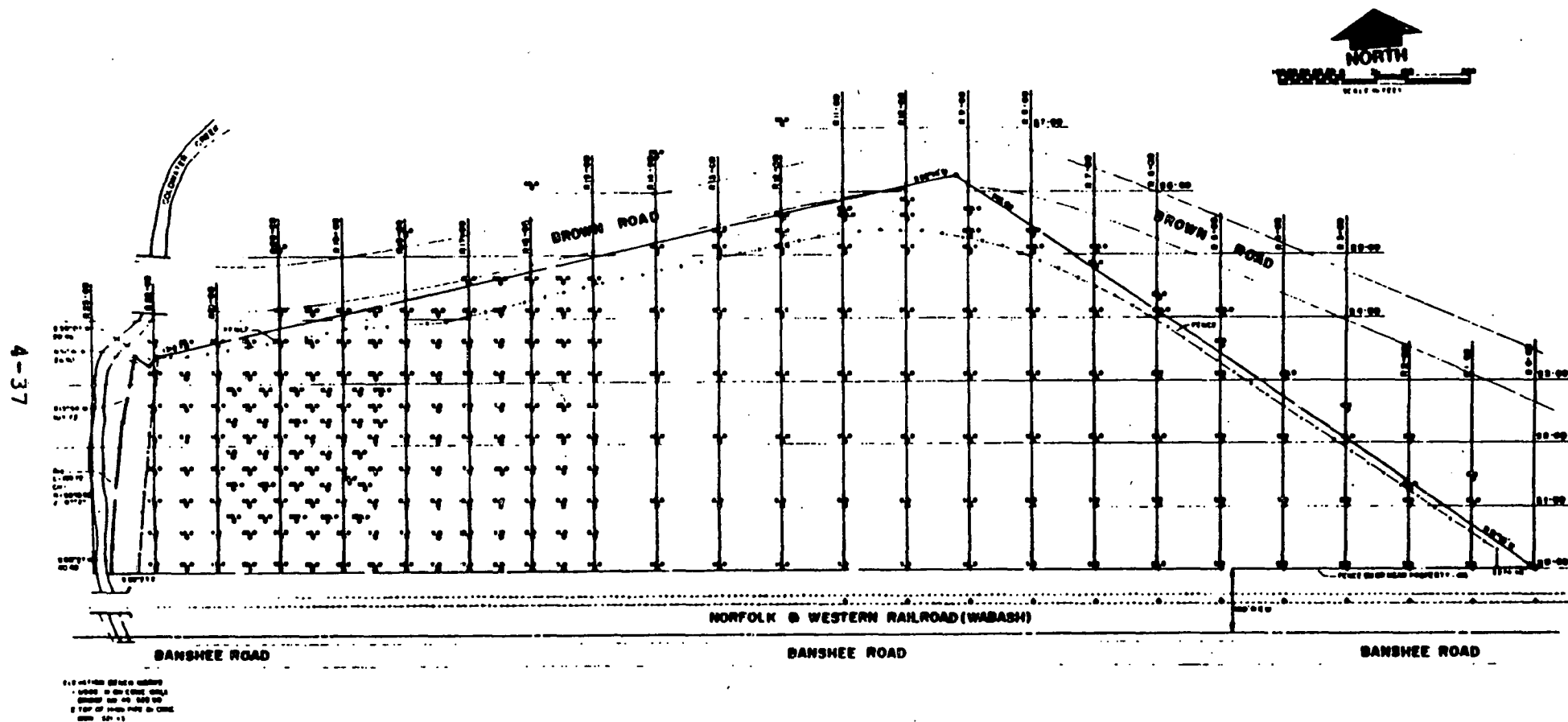
SURFACE CONTOUR / ELEVATION (FEET) - 1 FOOT INTERVAL

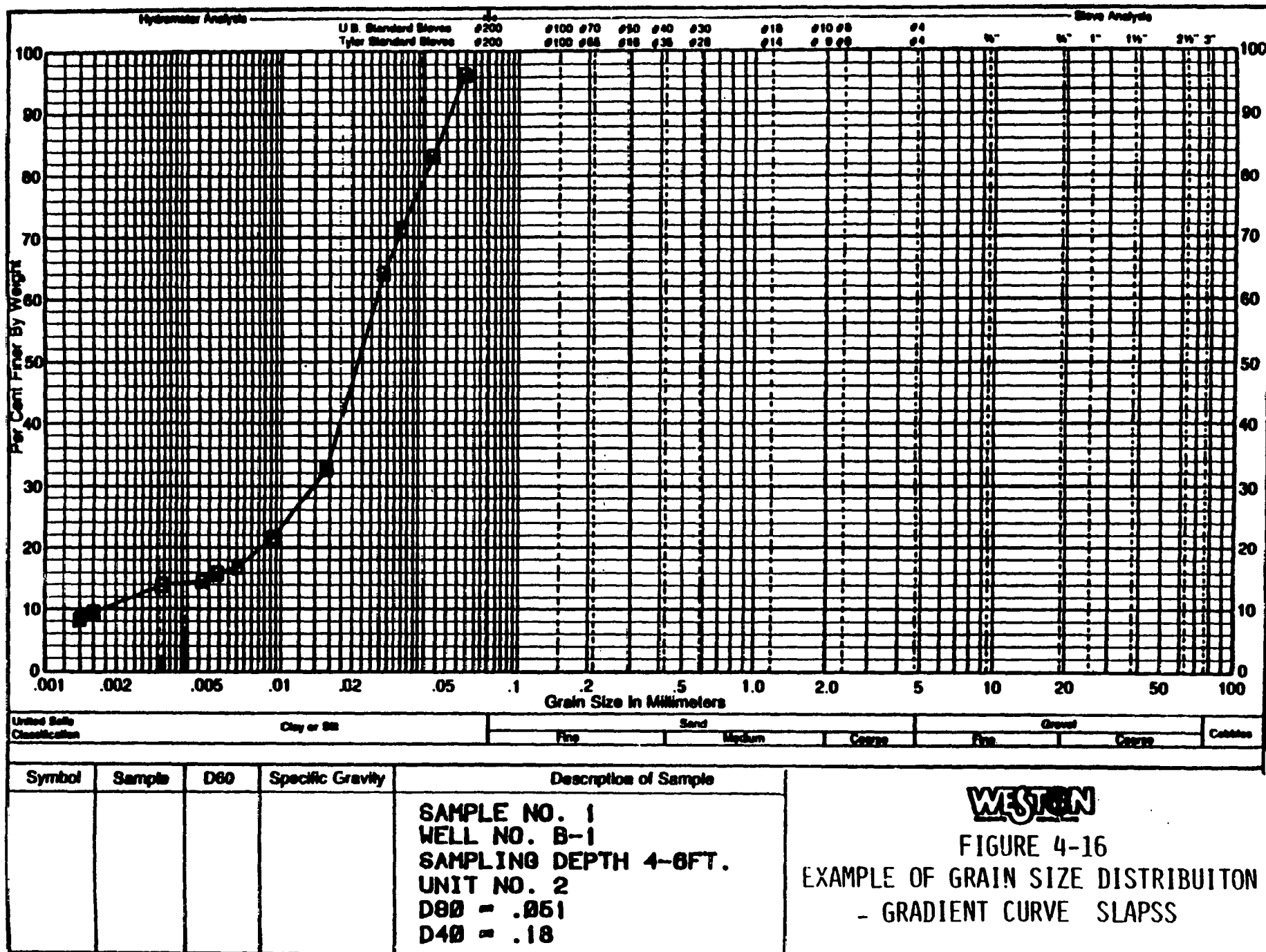
NOTE: THIS MAP IS BASED ON SITE SURVEYS
 BY RICHARD SURVEYING CO.

ST. LOUIS AIRPORT STORAGE SITE

WESTON
 100 YEARS OF SERVICE

FIGURE 4-14
 TWO DIMENSIONAL TOPOGRAPHIC CONTOURS -
 POINT VALUE MAP (1979) SLAPSS





WESTON

FIGURE 4-16
 EXAMPLE OF GRAIN SIZE DISTRIBUTION
 - GRADIENT CURVE SLAPSS

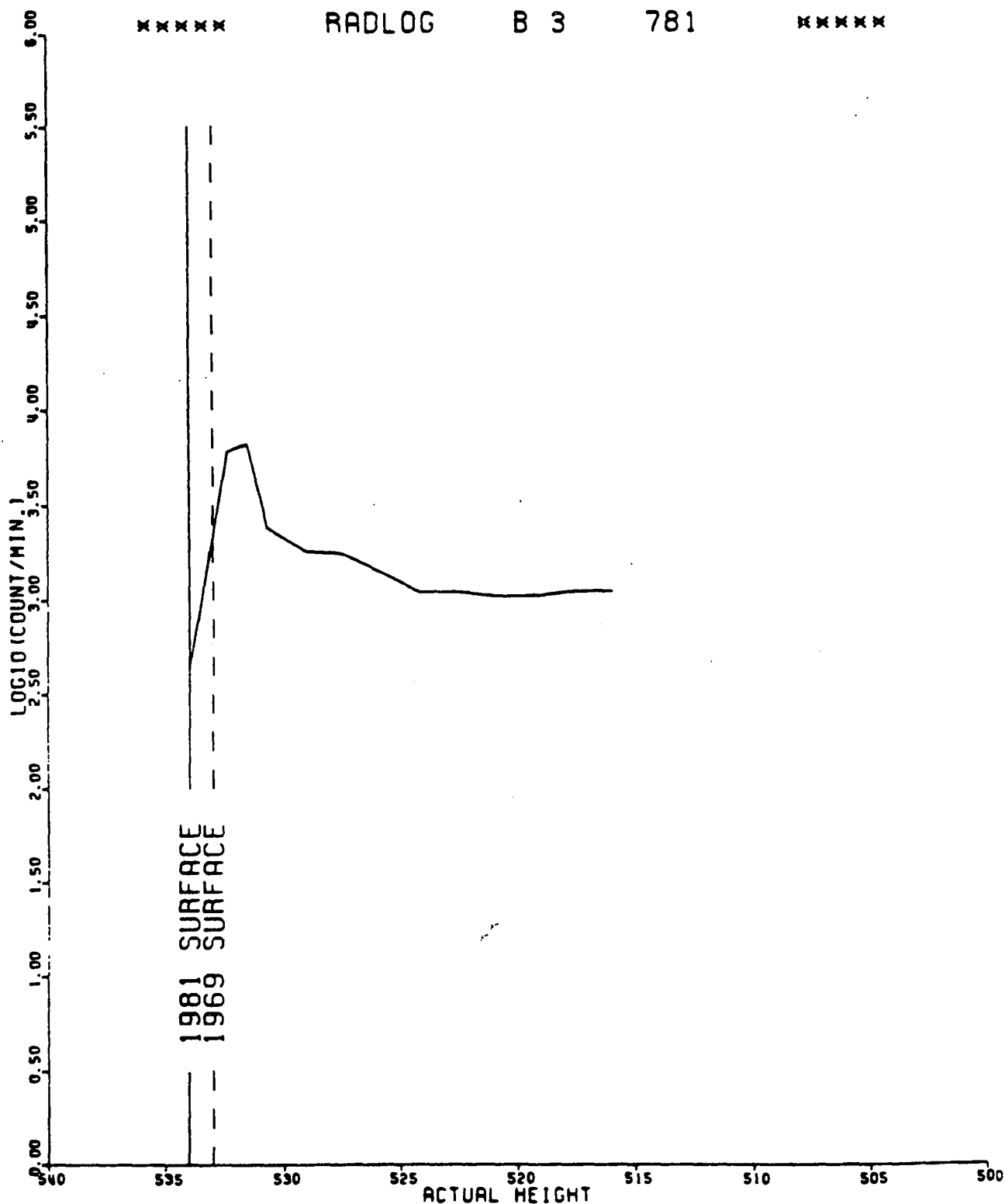


FIGURE 4-17
EXAMPLE OF X-Y PLOT OF GAMMA RADIATION
INTENSITY VERSUS DEPTH SLAPSS

HYDROMETER ANALYSIS DATA SHEET

PROJECT IDENTIFICATION -- STLOUIS

SAMPLE NO.	56	ANALYST	STANLEY
BEAKER & SAMPLE WT.	36.395	HYDROMETER NO.	2
SAMPLE WT. (WET)	35.000	TEMPERATURE	22.800
SAMPLE WT. (DRY)	34.195	DISPERSANT	CALGON
PERCENT WATER	2.300	CONCENTRATION	4.200
		UNIT ID.	3

TIME	T ^{1.5}	R	TEMP.	THETA	RL	C	CO	X	%	X-MILL
0.50	0.71	38.00	22.80	41.69	4.20	33.8	34.195	59.0	98.8	0.0590
1.00	1.00	35.10	22.80	42.66	4.20	30.9	34.195	42.7	90.4	0.0427
2.00	1.41	30.30	22.80	44.17	4.20	26.1	34.195	31.2	76.3	0.0312
3.00	1.73	26.00	22.80	45.58	4.20	21.8	34.195	26.3	63.8	0.0263
11.00	3.32	15.00	22.80	48.92	4.20	10.8	34.195	14.8	31.6	0.0148
30.00	5.48	11.20	22.80	50.11	4.20	7.0	34.195	9.1	20.5	0.0091
60.00	7.75	10.30	22.60	50.33	4.20	6.1	34.195	6.5	17.8	0.0065
90.00	9.49	9.70	22.20	51.01	4.20	5.5	34.195	5.4	16.1	0.0054
120.00	10.95	9.30	22.20	51.12	4.20	5.1	34.195	4.7	14.9	0.0047
270.00	16.43	9.10	21.90	51.23	4.20	4.9	34.195	3.1	14.3	0.0031
681.00	26.10	8.40	22.40	51.34	4.20	4.2	34.195	2.0	12.3	0.0020
1307.00	36.15	8.40	21.90	51.34	4.50	3.9	34.195	1.4	11.4	0.0014

D90 = 0.0424

D50 = 0.0214

D40 = 0.0178

UNIFORMITY COEFFICIENT 0.42

UNIT 3

FIGURE 4-18
EXAMPLE OF HYDROMETER ANALYSIS WORK SHEET
SLAPSS

WELL MASTERFILE DATA

ST LOUIS AIRPORT STORAGE SITE

RUN DATE: 9/ 2/81

WELL ID	CREATION DATE	WELL DEPTH	SAMPLED INTERVAL	CASING DIAMETER	X COORD	Y COORD	MPL (FEET)
P1	5/ 8/81	82.0	69.0-82.0	3.0	1810.00	100.00	526.50
P2	5/11/81	82.0	69.0-82.0	3.0	1810.00	120.00	526.50
P3	5/13/81	41.0	21.0-41.0	3.0	1810.00	130.00	526.30
P4	5/14/81	41.0	21.0-41.0	3.0	1830.00	130.00	526.50
A1	5/22/81	26.0	11.0-26.0	3.0	530.00	300.00	532.00
A2	5/21/81	27.0	12.0-27.0	3.0	650.00	50.00	534.60
A3	5/21/81	35.0	15.0-35.0	3.0	850.00	250.00	530.20
A4	5/22/81	25.0	10.0-25.0	3.0	1150.00	50.00	530.80
A5	5/15/81	44.0	27.0-44.0	3.0	1200.00	470.00	529.30
A6	5/15/81	44.0	27.0-44.0	3.0	1450.00	250.00	529.10
A7	5/15/81	44.0	27.0-44.0	3.0	1690.00	400.00	526.10
A8	5/22/81	39.0	19.0-39.0	3.0	2050.00	340.00	523.70
A9A	6/22/81	23.0	21.0-23.0	1.5	700.00	40.00	533.15
A9c	6/22/81	14.5	12.5-14.5	1.5	700.00	40.00	533.00
A9C	6/22/81	8.0	6.0- 8.0	1.5	700.00	40.00	533.15
A10A	6/23/81	42.0	40.0-42.0	1.5	1100.00	450.00	527.75
A10B	6/23/81	23.0	21.0-23.0	1.5	1100.00	450.00	527.76
A10C	6/23/81	8.0	6.0- 8.0	1.5	1100.00	450.00	527.76
A11A	6/24/81	42.0	40.0-42.0	1.5	2020.00	315.00	527.36
A11c	6/24/81	23.0	21.0-23.0	1.5	2020.00	315.00	527.34
A11C	6/24/81	12.0	10.0-12.0	1.5	2020.00	315.00	527.37
B1	12/ 1/80	54.0	22.0-54.0	4.0	1000.00	415.00	529.40
B2	12/ 1/80	53.0	32.0-53.0	4.0	400.00	100.00	526.30
B3	12/ 1/80	35.0	20.0-35.0	4.0	2000.00	200.00	535.10
A	10/ 8/79	30.0	15.0-30.0	3.0	2120.00	240.00	526.60
B	10/ 9/79	28.0	13.0-28.0	3.0	2175.00	110.00	526.90
C	10/10/79	24.0	14.0-24.0	3.0	2160.00	300.00	526.50
D	10/11/79	24.0	12.0-24.0	3.0	1930.00	350.00	524.20
E	10/11/79	20.0	10.0-20.0	3.0	700.00	450.00	531.30
F	10/12/79	24.0	12.0-24.0	3.0	140.00	35.00	544.00

FIGURE 4-19
EXAMPLE OF WELL MASTERFILE DATA SLAPSS

WESKIN

WATER TABLE/PIEZOMETRIC SURFACE DATA

ST LOUIS AIRPORT STORAGE SITE

RUN DATE: 9/ 3/81

WELL ID	DATE	DTW (FT)	MPE (FT)	GWE (FT)
A	12/17/80	16.90	30.00	13.10
B	12/17/80	19.00	28.00	9.00
C	12/17/80	18.80	24.00	5.20
D	12/17/80	12.10	24.00	11.90
E	12/17/80	14.90	20.00	5.10
F	12/17/80	11.40	24.00	12.60
A	5/ 5/81	15.31	30.00	14.69
B	5/ 5/81	18.02	28.00	9.98
C	5/ 5/81	17.16	24.00	6.84
D	5/ 5/81	10.43	24.00	13.57
E	5/ 5/81	11.93	20.00	8.07
F	5/ 5/81	12.20	24.00	11.80
B1	5/ 5/81	11.34	52.00	40.66
B2	5/ 5/81	15.41	53.00	37.59
B3	5/ 5/81	10.70	35.00	24.30
A	5/ 7/81	15.10	30.00	14.90
B	5/ 7/81	18.00	28.00	10.00
C	5/ 7/81	17.00	24.00	7.00
D	5/ 7/81	9.18	24.00	14.82
E	5/ 7/81	11.60	20.00	8.40
F	5/ 7/81	12.05	24.00	11.95
B1	5/ 7/81	11.10	52.00	40.90
B2	5/ 7/81	15.05	53.00	37.95
B3	5/ 7/81	10.42	35.00	24.58
A	5/11/81	14.54	30.00	15.46
B	5/11/81	17.30	28.00	10.70
C	5/11/81	16.24	24.00	7.76
D	5/11/81	7.15	24.00	16.85
E	5/11/81	11.06	20.00	8.94
F	5/11/81	11.23	24.00	12.77
B1	5/11/81	10.20	52.00	41.80
B2	5/11/81	14.60	53.00	38.40
B3	5/11/81	9.54	35.00	25.46
A	5/14/81	13.95	30.00	16.05
B	5/14/81	16.95	28.00	11.05
C	5/14/81	15.95	24.00	8.05
D	5/14/81	7.80	24.00	16.20
E	5/14/81	10.72	20.00	9.28
F	5/14/81	11.64	24.00	12.36
B1	5/14/81	10.03	52.00	41.97
B2	5/14/81	14.10	53.00	38.90
B3	5/14/81	8.50	35.00	26.50

FIGURE 4-20
EXAMPLE OF WATER TABLE/PIEZOMETRIC
SURFACE DATA SLAPSS

RUN DATE: 10/ 1/78

RUN DATE: 10/ 1/78

RW1			RW2			RW3			RW4		
GEOLOGICAL CODE	FROM	TO	GEOLOGICAL CODE	FROM	TO	GEOLOGICAL CODE	FROM	TO	GEOLOGICAL CODE	FROM	TO
A	0.	2.	A	0.	1.	D	0.	34.	A	0.	2.
C	2.	15.	D	1.	6.	E	34.	40.	D	2.	6.
D	15.	22.	L	6.	21.	I	40.	54.	L	6.	17.
E	22.	28.	K	21.	32.	L	54.	63.	J	17.	29.
G	28.	31.	J	32.	80.	N	63.	94.	L	29.	53.
J	31.	35.	O	80.	137.	K	94.	97.	J	53.	61.
O	35.	82.	K	137.	140.	N	97.	121.	N	61.	97.
N	82.	125.	L	140.	145.	J	121.	131.	M	97.	110.
O	125.	131.	*	0.	0.	O	131.	148.	O	110.	115.
L	131.	140.		0.	0.	L	148.	153.	L	115.	122.
*	0.	0.		0.	0.	*	0.	0.	*	0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.
	J.	0.		0.	0.		0.	0.		0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.
	J.	0.		0.	0.		0.	0.		0.	0.
	C.	0.		0.	0.		0.	0.		0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.
	0.	0.		0.	0.		0.	0.		0.	0.

FIGURE 4-21
EXAMPLE OF WELL LOG DATA SLAPSS

Site: SLAPPS

Chronology of Key Events

<u>Date</u>	<u>Event</u>
1946-1965	Waste storage area - Mallinckrodt Chemical (uranium processing) and the Manhattan Engineering District
Sept. 1965	Topographical survey - Rowland Surveying Company
Nov. 1965	Radiological survey waste inventory -- AEC
1966	Residual piles removed by Continental Mining & Milling Company
Dec. 1966	Surface radiological survey (beta-gamma only) -- AEC
1969	Removal of AJ-4 residue to Weldon Springs and razing of all structures -- St. Louis Airport Authority
Dec. 1969	Radiological survey -- AEC-ORO
Dec. 1969	Prefill topographical survey -- Rowland Surveying Company
1970	Fill dirt dumped on site (minimum of 1 foot with 2-3 feet on "hot spots") -- St. Louis Airport Authority
Oct. 1971	Postfill topographical survey -- Rowland Surveying Company
Nov. 1971	Postfill surface radiological survey (cleanup complete) -- AEC-ORO
Nov. 1976	Radiological survey -- ORNL
Jan. 1977	Topographical survey -- Rowland Surveying Company

FIGURE 4-22
CHRONOLOGY OF KEY EVENTS SLAPSS

VOLUMETRIC CALCULATION
LATTY AVENUE SITE

SECTION NUMBER	SECTION VOLUME CU. FT.	CUMULATIVE VOLUME CU. FT.	CUMULATIVE VOLUME CU. YD.
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.0	0.0
5	0.0	0.0	0.0
6	3.68	3.68	0.14
7	365.07	368.75	13.66
8	1308.49	1677.24	62.12
9	3164.74	4841.97	179.33
10	6658.85	11500.82	425.96
11	10289.13	21789.95	807.04
12	13480.86	35270.82	1306.33
13	16651.71	51922.53	1923.06
14	19481.94	71404.44	2644.61
15	23184.54	94588.94	3503.29
16	27880.42	122469.31	4535.90
17	31154.90	153624.19	5689.78
18	33181.02	186805.19	6916.71
19	33210.52	220015.69	8146.73
20	29666.97	249684.63	9247.56
21	23915.16	273599.75	10133.32
22	17113.77	290713.50	10767.16
23	11108.59	301822.06	11176.59
24	6542.10	308364.13	11420.89
25	3286.03	311652.13	11542.67
26	1471.98	313024.06	11593.46
27	389.20	313413.25	11607.49
28	29.51	313442.75	11608.99
29	0.0	313442.75	11608.99
30	0.0	313442.75	11608.99
31	0.0	313442.75	11608.99
32	0.0	313442.75	11608.99
33	0.0	313442.75	11608.99
34	0.0	313442.75	11608.99
35	0.0	313442.75	11608.99

FIGURE 4-23
EXAMPLE OF VOLUME OF CROSS-SECTIONAL
SEGMENTS OF A GIVEN MASS SLAPSS

SECTION 5**CONCLUSION**

In summary, the work performed under this phase of the project has included the development of a conceptual systems design for a data management system to support the SLAPSS/FUSRAP research project and the implementation of the specific basic software modules necessary to support the on-going activity of this phase of the project.

With the exception of the core data base software (DMS 1100), all of the specific modules detailed herein have been implemented on WESTON's computer and successfully used in support of the site characterization and conceptual engineering activities described in Volumes 1 and 2 of the SLAPSS Technical Series. Late delivery of the DMS 1100 software prevented implementation of the data base segment of the system under this phase, and resulted in the use of a transitional data file structure in order to meet the data management/analysis requirements of the on-going project activities.

In conclusion, the data management system thus developed and presented in this document is capable of supporting the future activities of the SLAPSS project as well as any other FUSRAP site, whether individually, or on a programmatic multiple-site basis.